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(54) **DETERMINING GEOGRAPHICAL POSITION IN IPV6 NETWORKS**

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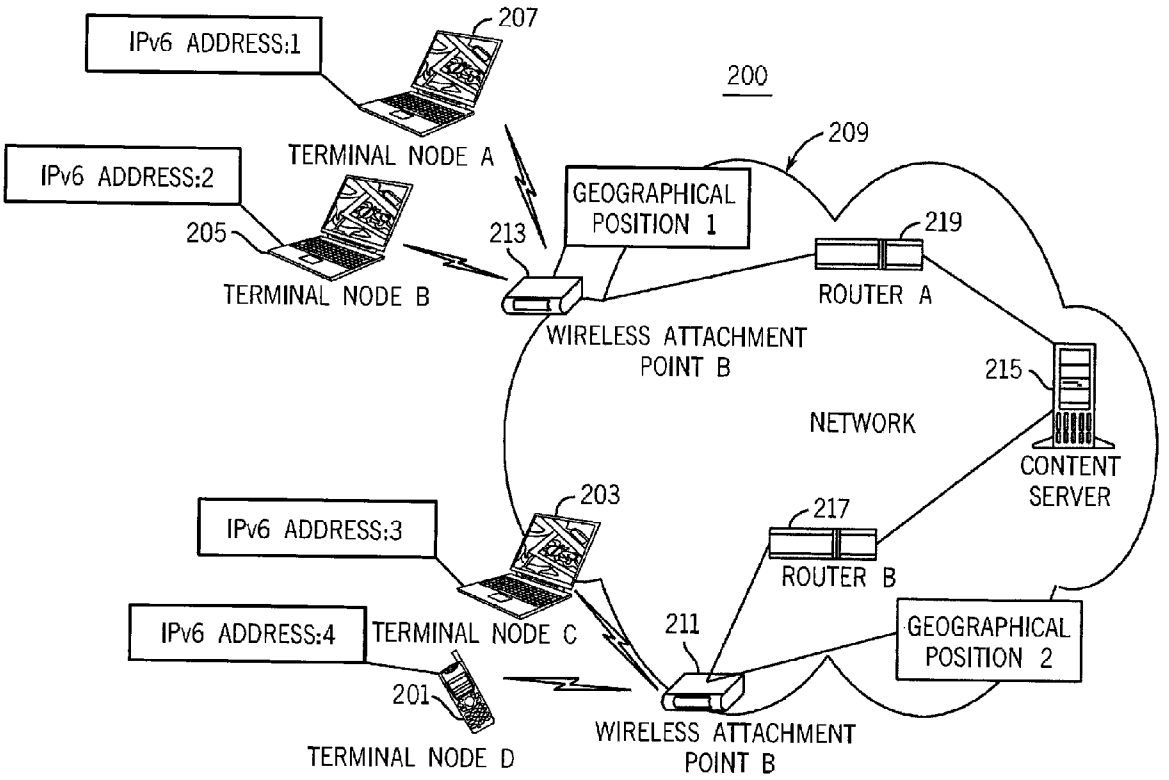
(52) **U.S. Cl.** ..... **455/456.2**

(57) **ABSTRACT**

A computer-readable medium, device and system for responding to a request for a geographically-based service are provided. A request for a geographically-based service is received. The received request indicates that a geographical position of a target node and a radius associated with a maximum distance from the geographical position is requested. A requesting service message is formatted that is associated with a higher-layer protocol and includes an indicator indicating that the geographical position of the target node and the radius is requested. The requesting service message is merged in a first header of a requesting datagram which is sent to the target node. A reply datagram is received from the target node and a reply position message component is extracted from the received reply datagram. A reply position message component is extracted from a second header of the received reply datagram. The first geographical position of the target node and the radius from the extracted reply position message component is determined. A response to the received request is provided based on the determined radius and the determined geographical position.



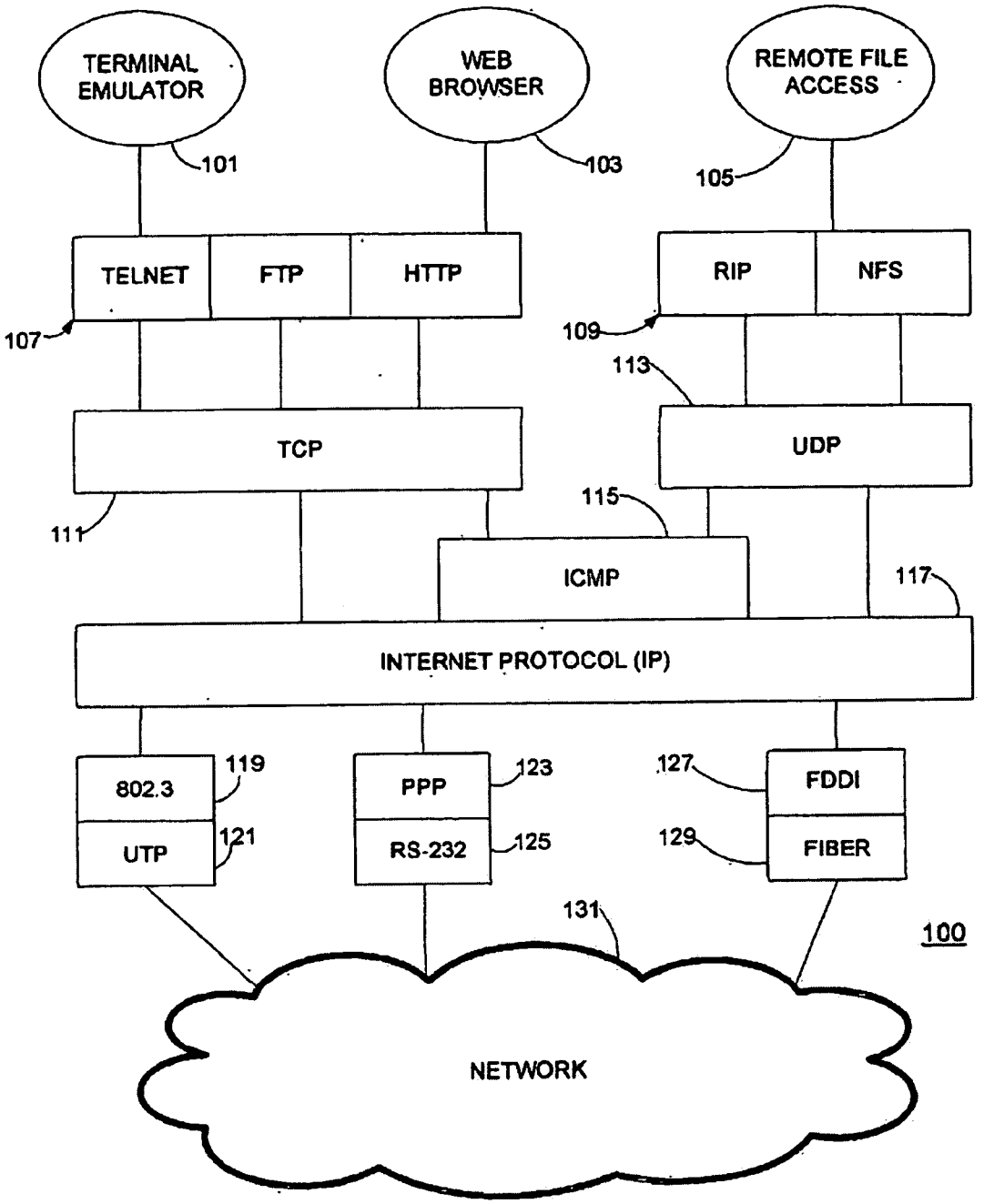



FIG. 1
(PRIOR ART)

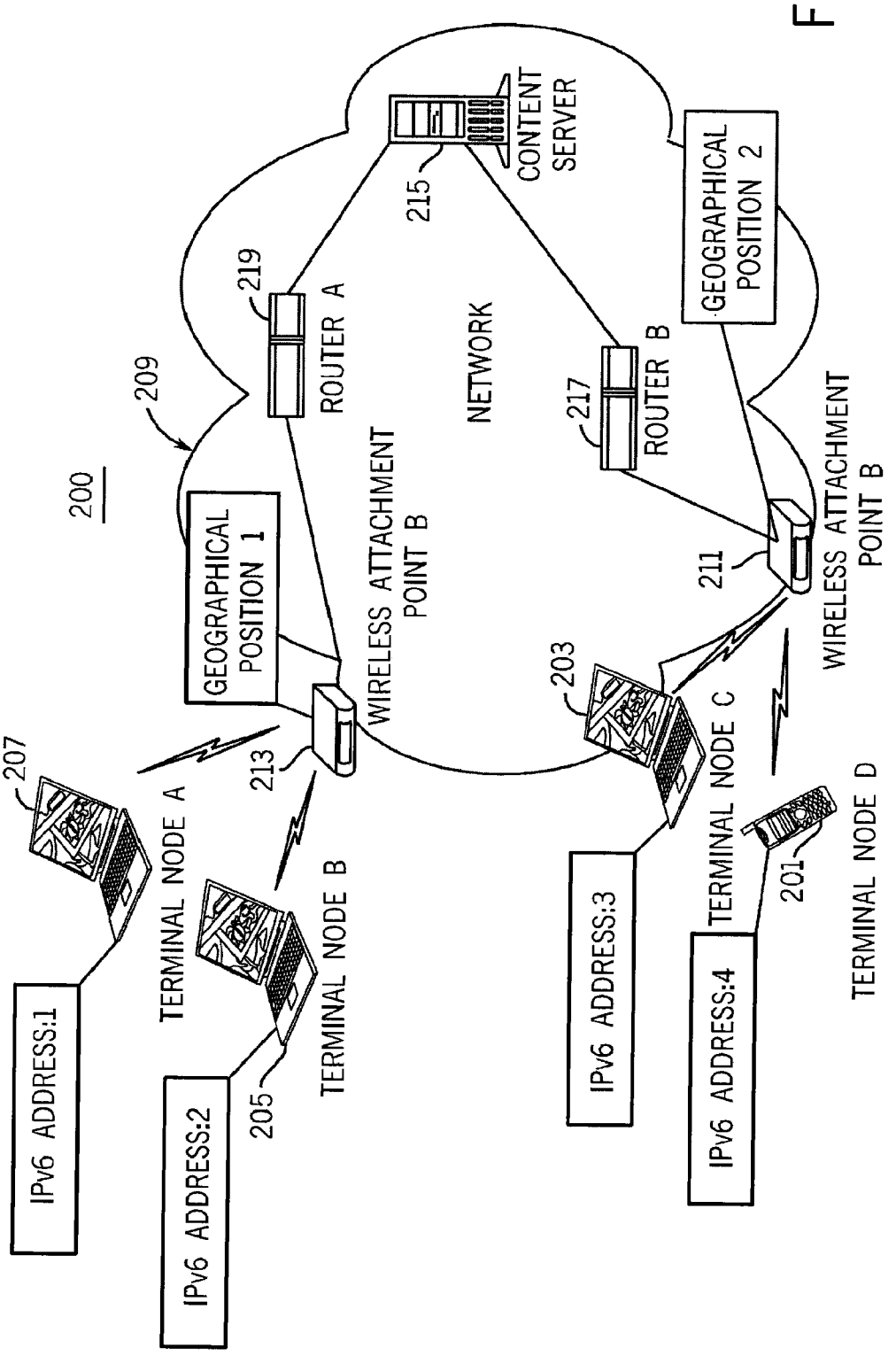

200
209
GEOGRAPHICAL POSITION 1
GEOGRAPHICAL POSITION 2
219
ROUTER A
215
CONTENT SERVER
NETWORK
217
ROUTER B
WIRELESS ATTACHMENT POINT B
211
WIRELESS ATTACHMENT POINT B
213
203
207
TERMINAL NODE A
TERMINAL NODE B
TERMINAL NODE C
TERMINAL NODE D
205
201
IPv6 ADDRESS:1
IPv6 ADDRESS:2
IPv6 ADDRESS:3
IPv6 ADDRESS:4

FIG. 2

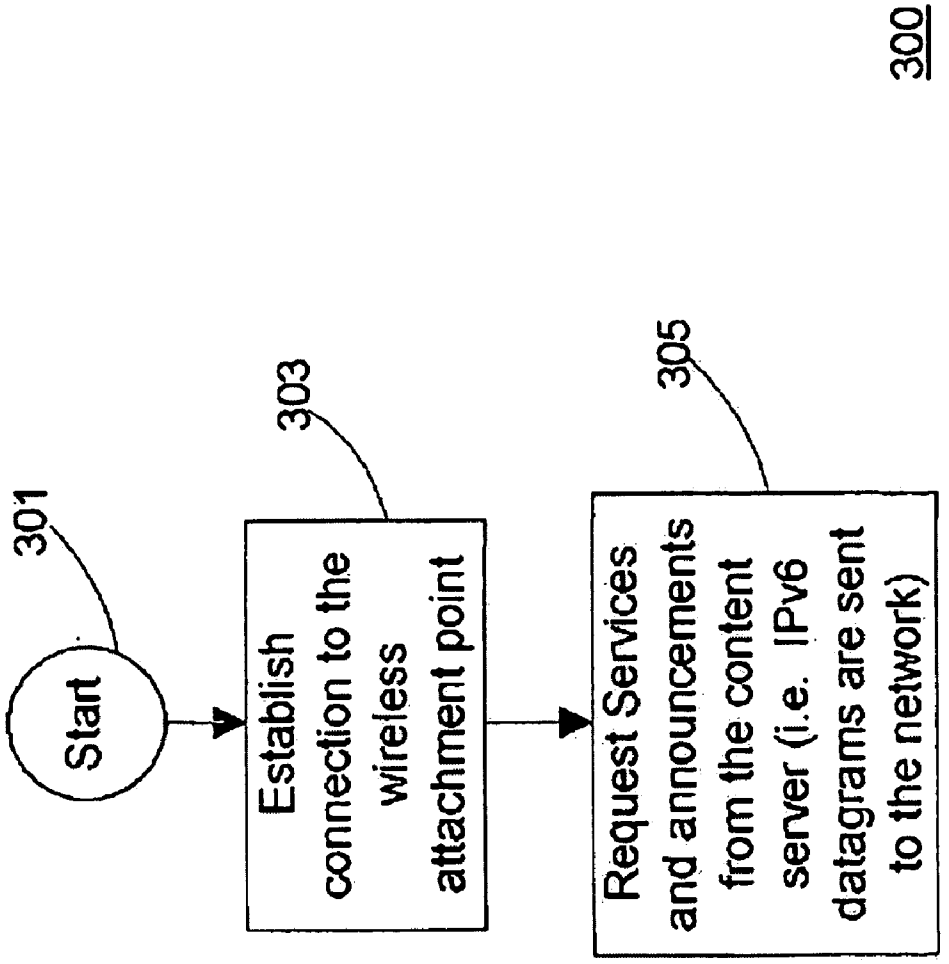

300
301
Start
303
Establish connection to the wireless attachment point
305
Request Services and announcements from the content server (i.e. IPv6 datagrams are sent to the network)

FIG. 3

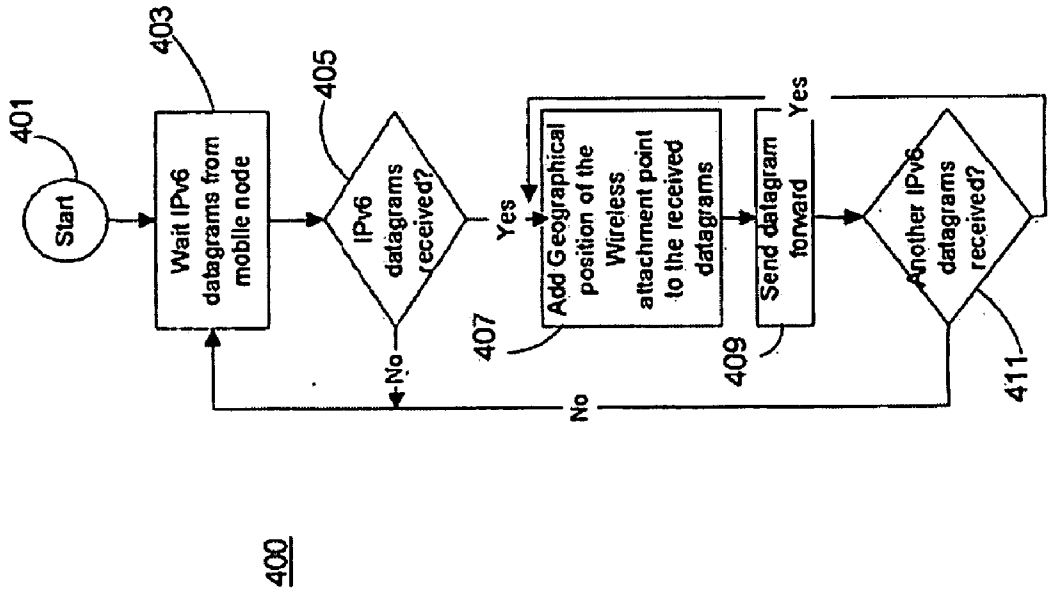

400
401
Start
403
Wait IPv6 datagrams from mobile node
405
IPv6 datagrams received?
Yes
No
407
Add Geographical position of the Wireless attachment point to the received datagrams
409
Send datagram forward
411
Another IPv6 datagrams received?
Yes
No

FIG. 4

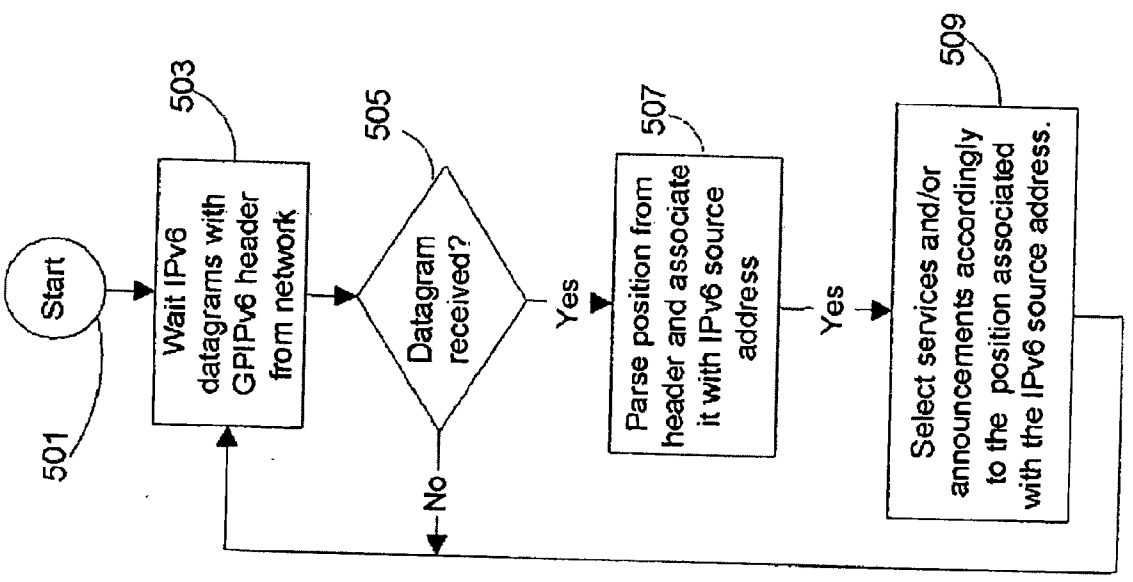

500
Start
501
Wait IPv6 datagrams with GPIPv6 header from network
503
Datagram received?
505
Yes
No
Parse position from header and associate it with IPv6 source address
507
Yes
Select services and/or announcements accordingly to the position associated with the IPv6 source address.
509

FIG. 5

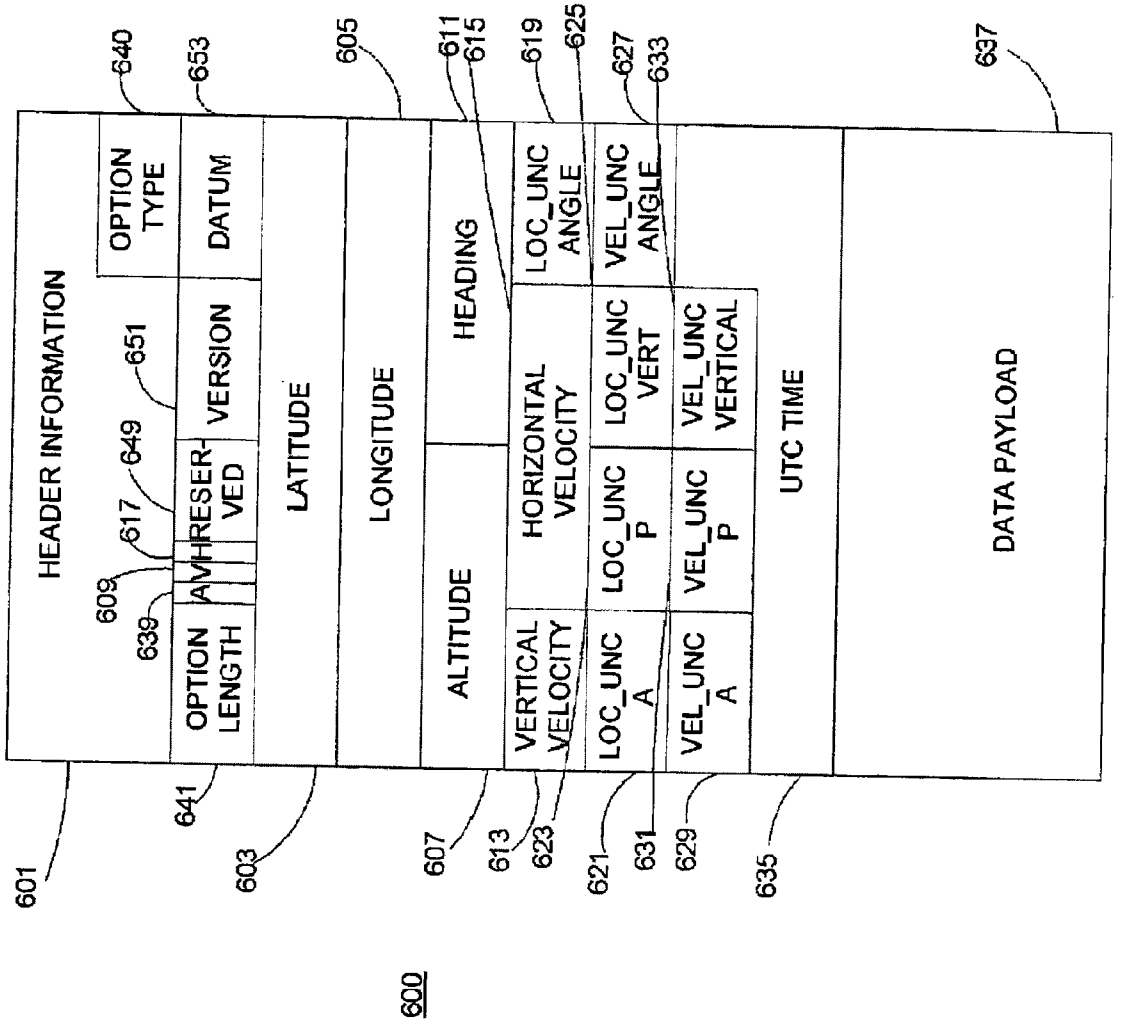

HEADER INFORMATION
OPTION LENGTH
A/H
RESERVED
VERSION
OPTION TYPE
DATUM
LATITUDE
LONGITUDE
ALTITUDE
HEADING
VERTICAL VELOCITY
HORIZONTAL VELOCITY
LOC_UNC A
LOC_UNC P
LOC_UNC VERT
LOC_UNC ANGLE
VEL_UNC A
VEL_UNC P
VEL_UNC VERTICAL
VEL_UNC ANGLE
UTC TIME
DATA PAYLOAD
601
603
605
607
609
611
613
615
617
619
621
623
625
627
629
631
633
635
637
639
640
641
649
651
653
600

FIG. 6

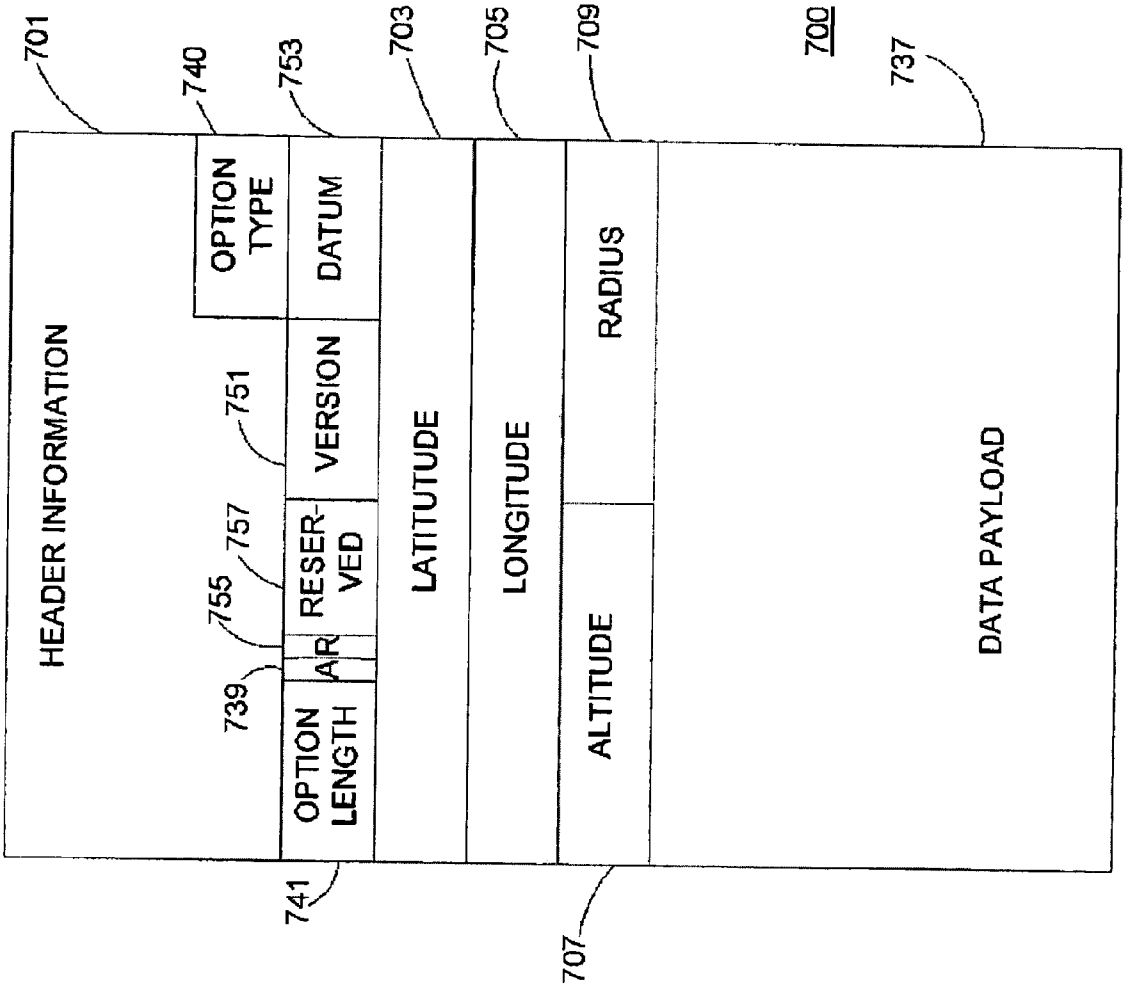

701
740
753
703
705
709
700
737
HEADER INFORMATION
OPTION TYPE
DATUM
751
VERSION
757
RESER-VED
755
AR
739
OPTION LENGTH
LATITUTUDE
LONGITUDE
RADIUS
ALTITUDE
DATA PAYLOAD
741
707

FIG. 7

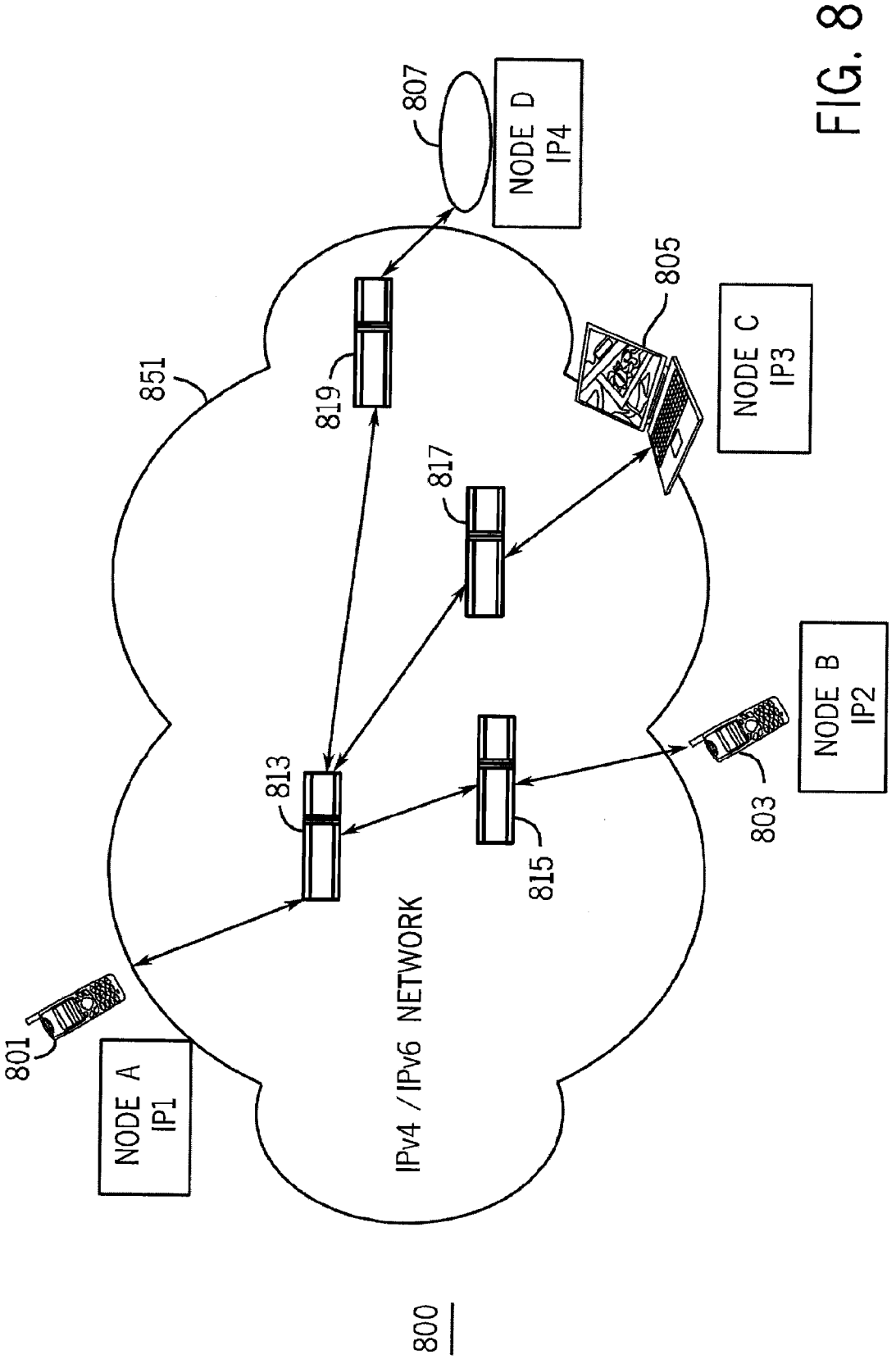
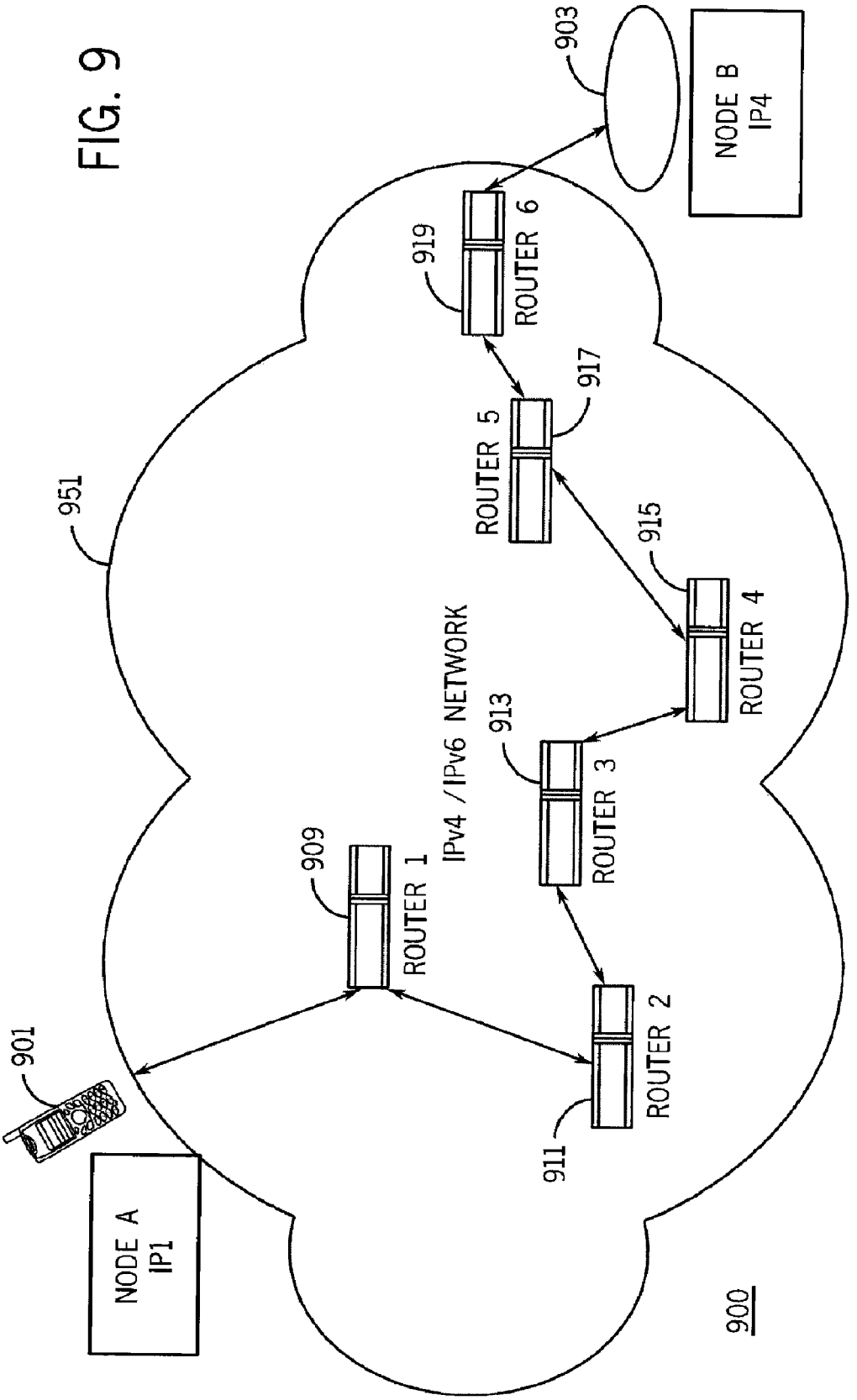

800
IPv4 / IPv6 NETWORK
851
NODE A
IP1
801
NODE B
IP2
803
NODE C
IP3
805
NODE D
IP4
807
813
815
817
819

FIG. 8

FIG. 9


903
NODE B
IP4
919
ROUTER 6
917
ROUTER 5
915
ROUTER 4
951
IPv4 /IPv6 NETWORK
913
ROUTER 3
909
ROUTER 1
901
ROUTER 2
911
NODE A
IP1
900

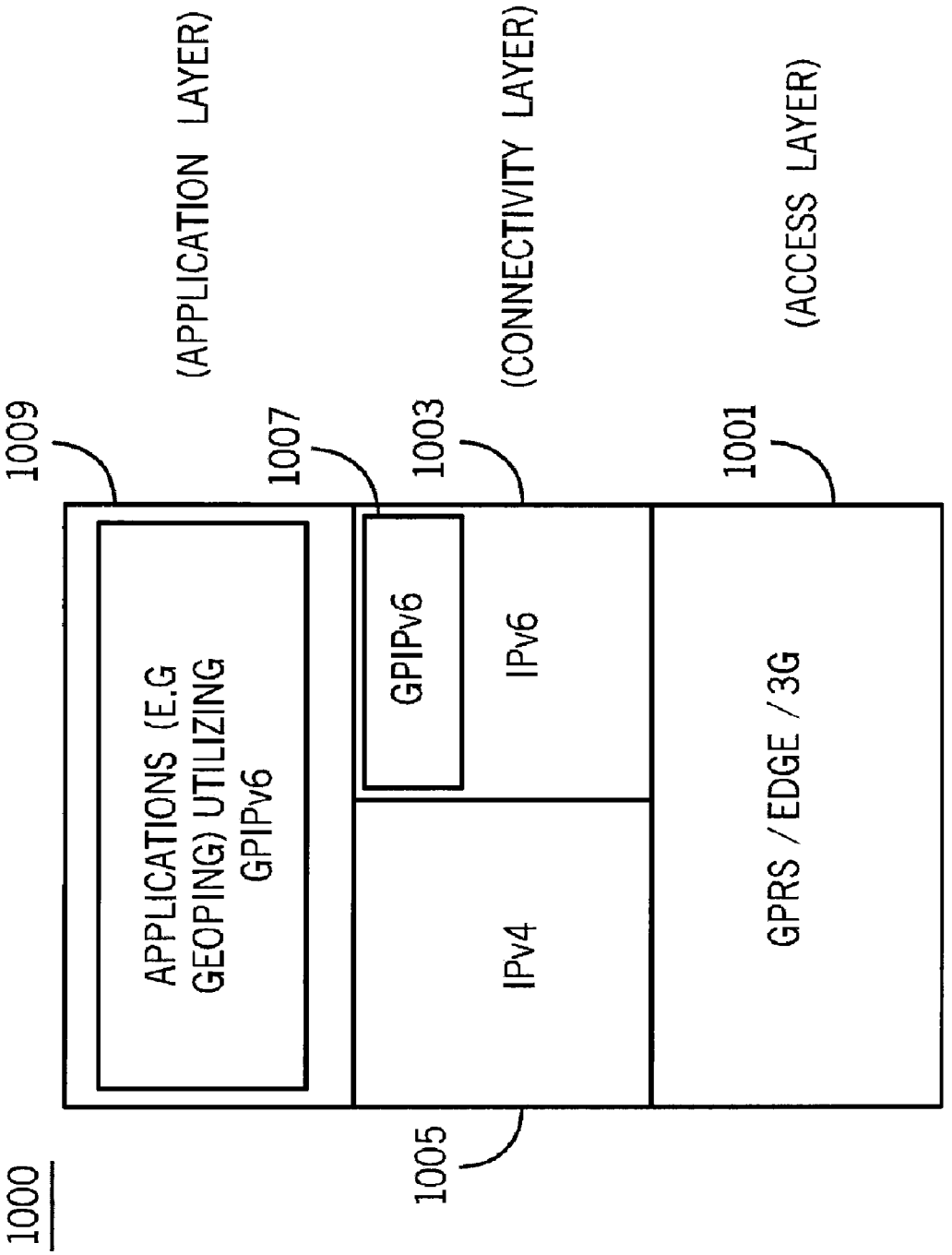

1000
1009
1007
1003
1001
1005
(APPLICATION LAYER)
(CONNECTIVITY LAYER)
(ACCESS LAYER)
APPLICATIONS (E.G GEOPING) UTILIZING GPIPv6
GPIPv6
IPv6
IPv4
GPRS / EDGE / 3G

FIG. 10

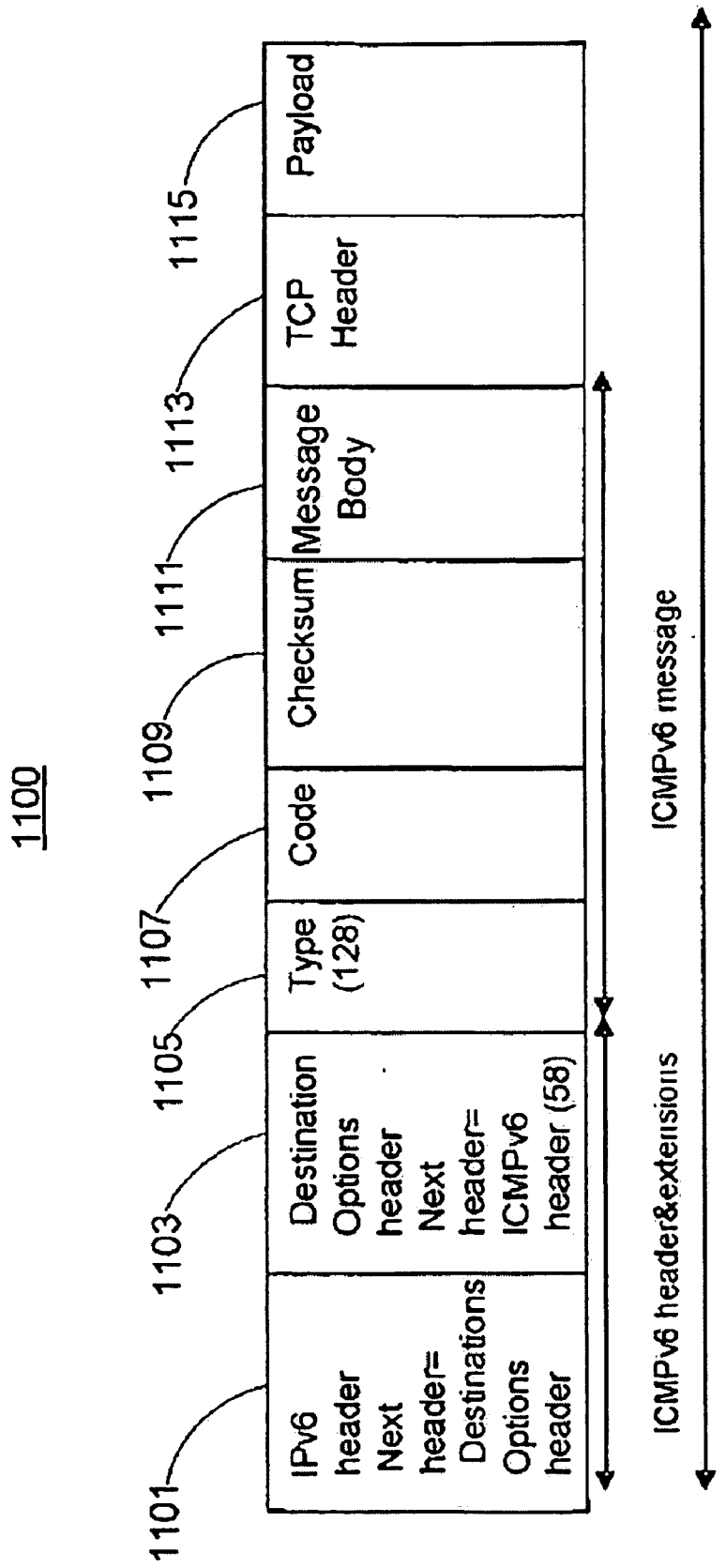

1100
1101
IPv6 header Next header= Destinations Options header
1103
Destination Options header Next header= ICMPv6 header (58)
1105
Type (128)
1107
Code
1109
Checksum
1111
Message Body
1113
TCP Header
1115
Payload
ICMPv6 header&extensions
ICMPv6 message
Ipv6 datagram fields

FIG. 11

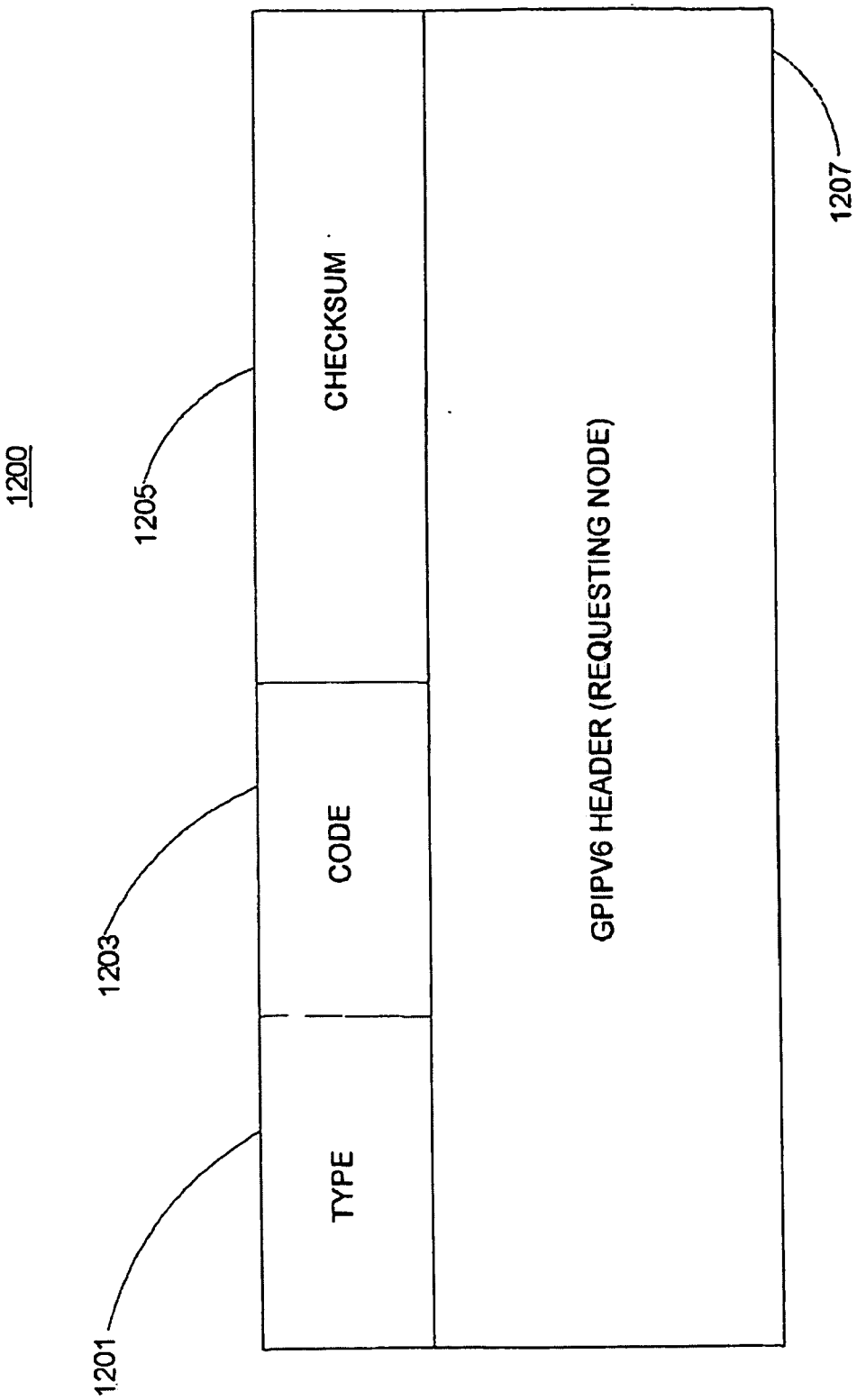

1200
1201
TYPE
1203
CODE
1205
CHECKSUM
1207
GPIPV6 HEADER (REQUESTING NODE)

FIG. 12

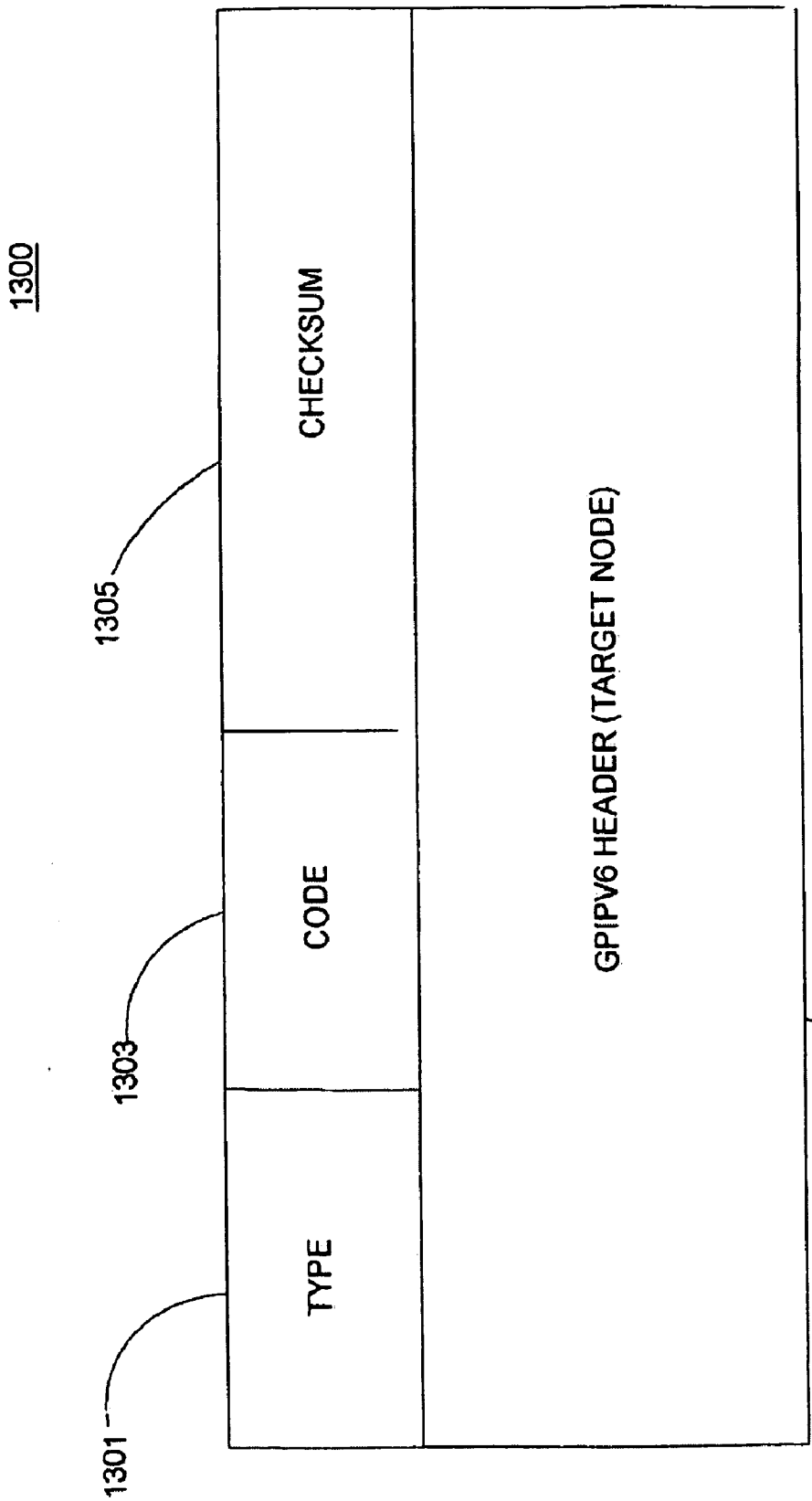

1300
CHECKSUM
CODE
TYPE
GP(IPV6 HEADER (TARGET NODE)
1305
1303
1301
1307

FIG. 13

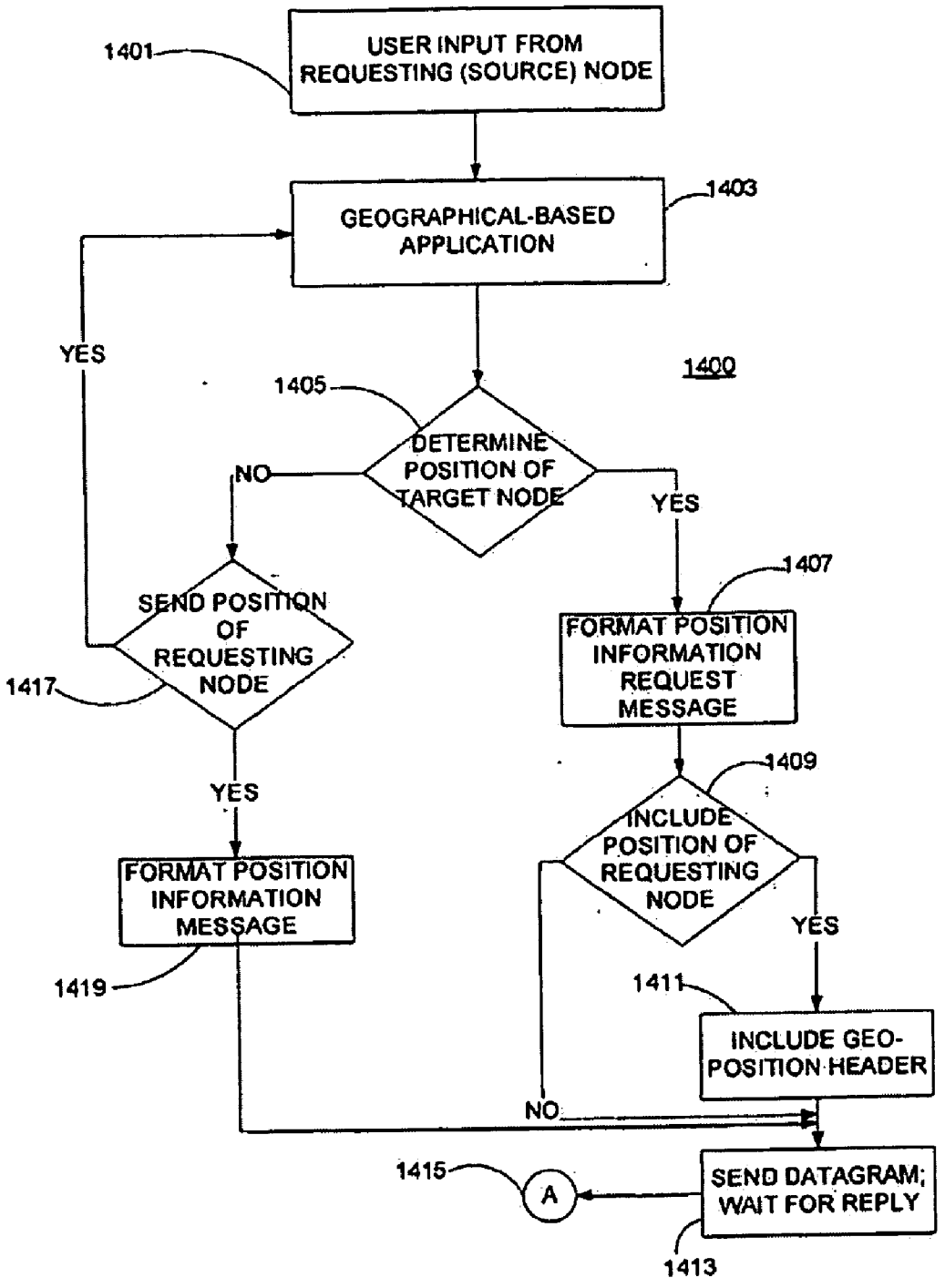

1401
USER INPUT FROM REQUESTING (SOURCE) NODE
GEOGRAPHICAL-BASED APPLICATION
1403
1400
YES
1405
DETERMINE POSITION OF TARGET NODE
NO
YES
SEND POSITION OF REQUESTING NODE
1417
FORMAT POSITION INFORMATION REQUEST MESSAGE
1407
YES
1409
INCLUDE POSITION OF REQUESTING NODE
FORMAT POSITION INFORMATION MESSAGE
1419
YES
1411
INCLUDE GEO-POSITION HEADER
NO
1415
A
SEND DATAGRAM; WAIT FOR REPLY
1413

FIG. 14

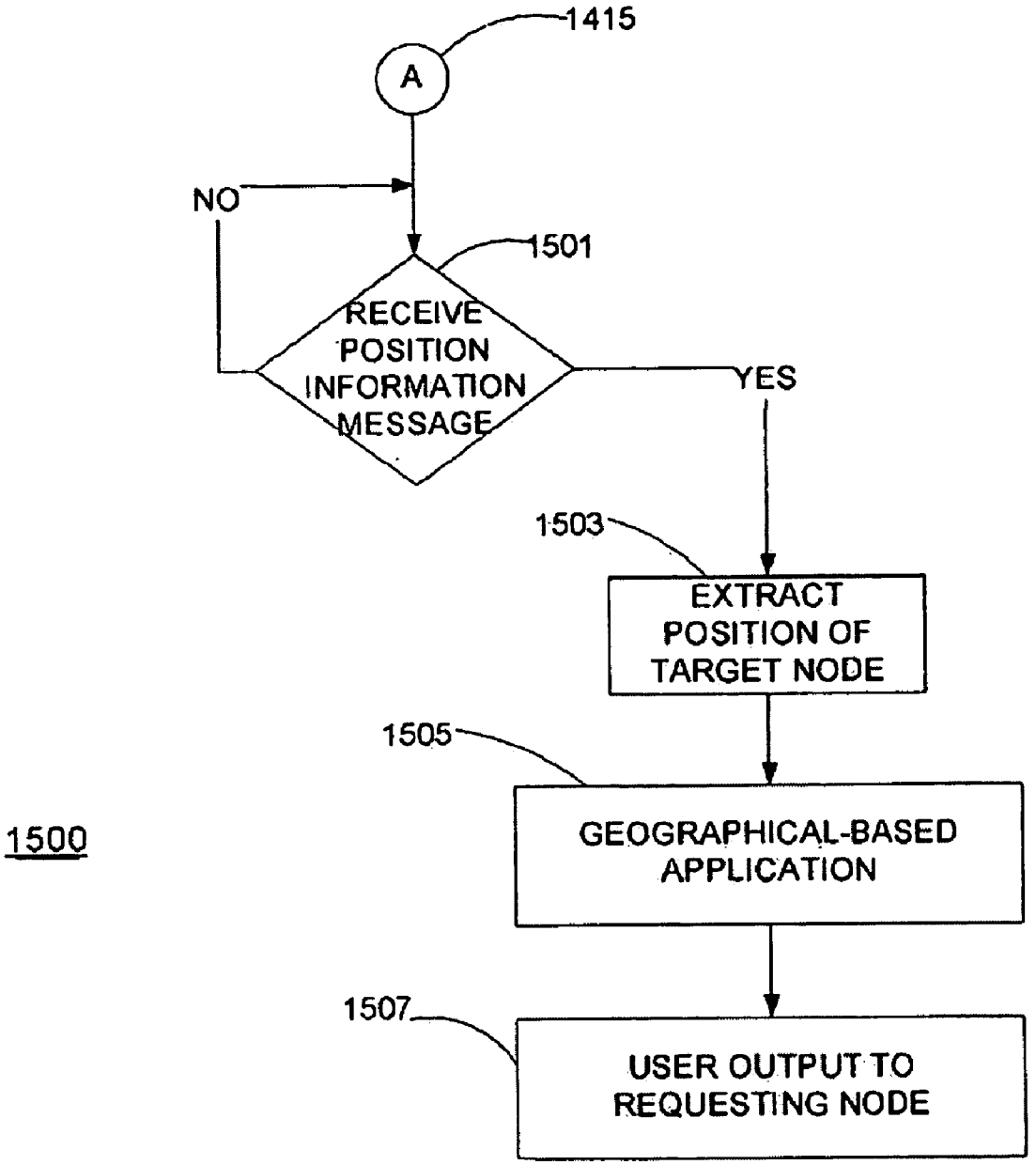

1415
A
NO
1501
RECEIVE POSITION INFORMATION MESSAGE
YES
1503
EXTRACT POSITION OF TARGET NODE
1505
GEOGRAPHICAL-BASED APPLICATION
1500
1507
USER OUTPUT TO REQUESTING NODE

FIG. 15

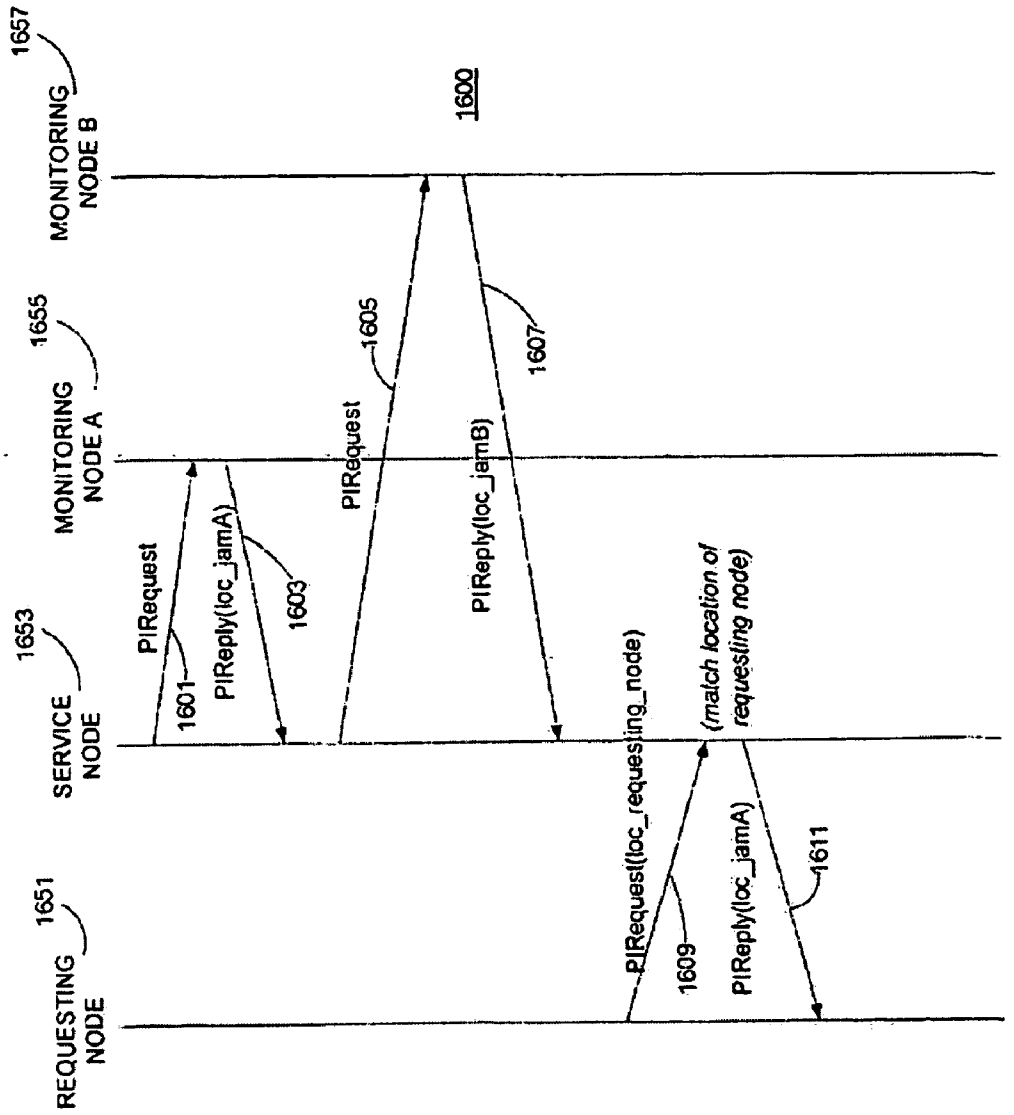
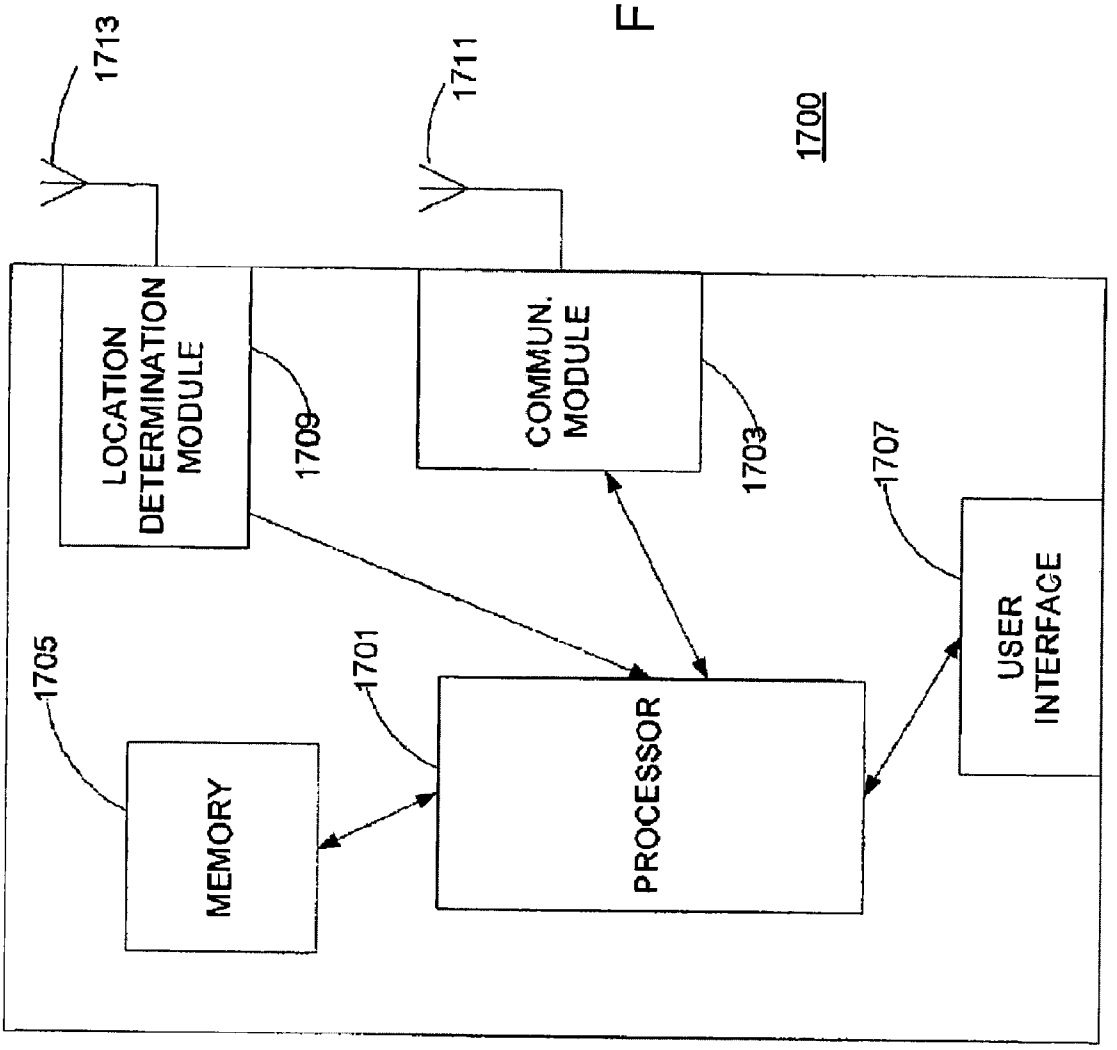

1600
1657
MONITORING NODE B
1655
MONITORING NODE A
1653
SERVICE NODE
1651
REQUESTING NODE
PIRequest
1601
PIReply(loc_jamA)
1603
PIRequest
1605
PIReply(loc_jamB)
1607
PIRequest(loc_requesting_node)
1609
(match location of requesting node)
PIReply(loc_jamA)
1611

FIG. 16

FIG. 17


1700
1713
1711
LOCATION DETERMINATION MODULE
1709
COMMUN. MODULE
1703
1707
USER INTERFACE
1705
MEMORY
1701
PROCESSOR

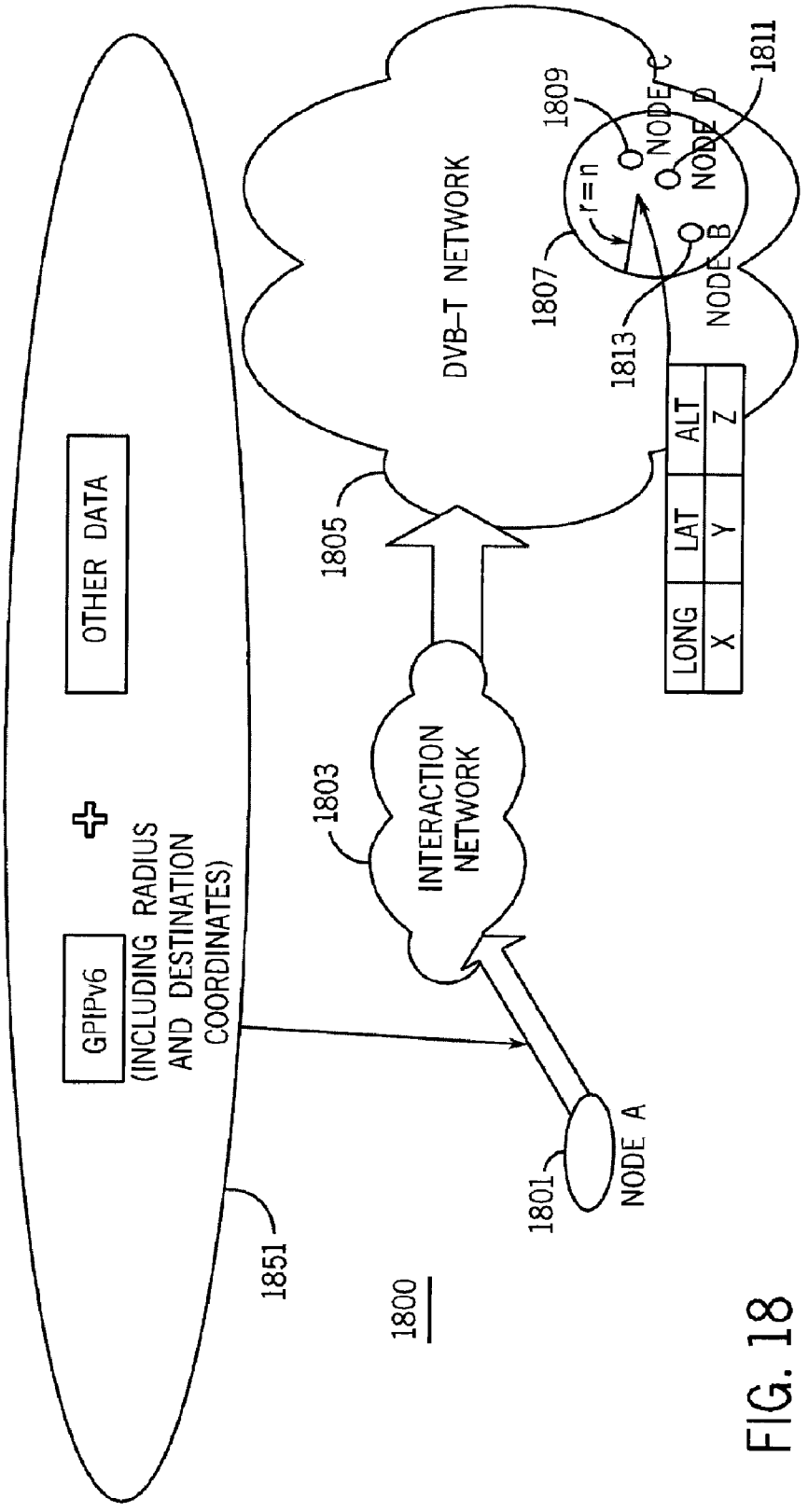

1851
GPIPv6
(INCLUDING RADIUS AND DESTINATION COORDINATES)
OTHER DATA
1800
1801
NODE A
1803
INTERACTION NETWORK
1805
DVB-T NETWORK
1807
1809
NODE C
NODE D
NODE B
r=n
1811
1813
LONG
X
LAT
Y
ALT
Z

FIG. 18

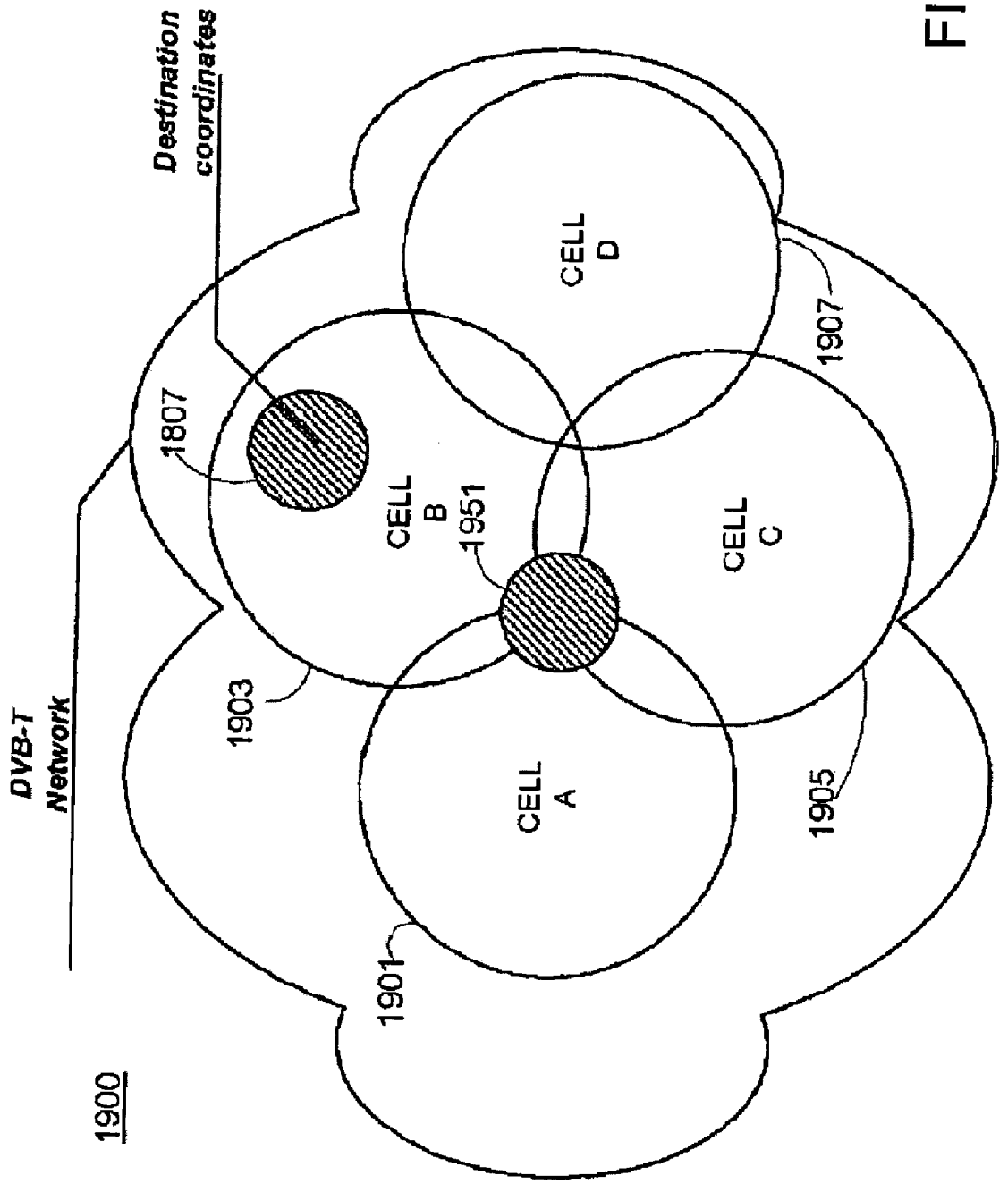

1900
DVB-T Network
Destination coordinates
1807
1903
1901
1905
1907
1951
CELL A
CELL B
CELL C
CELL D

FIG. 19

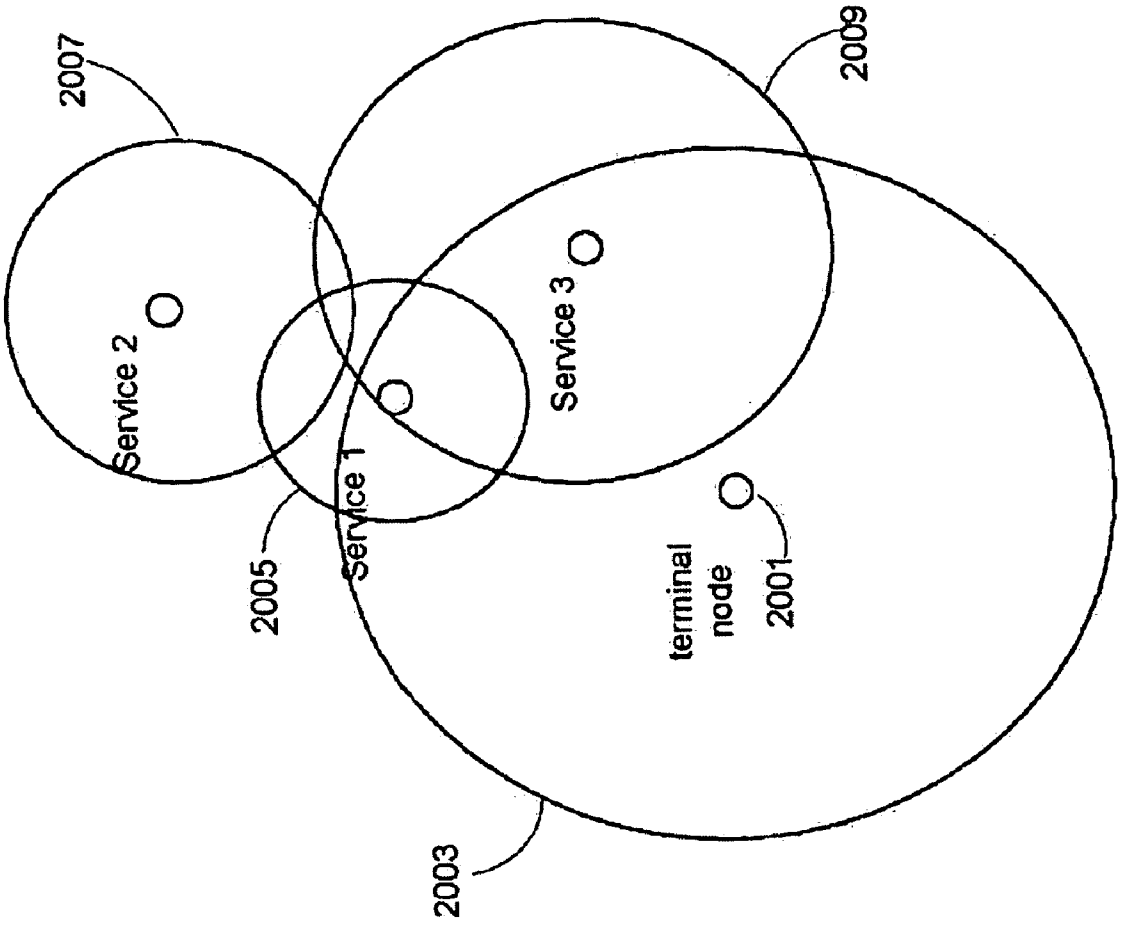
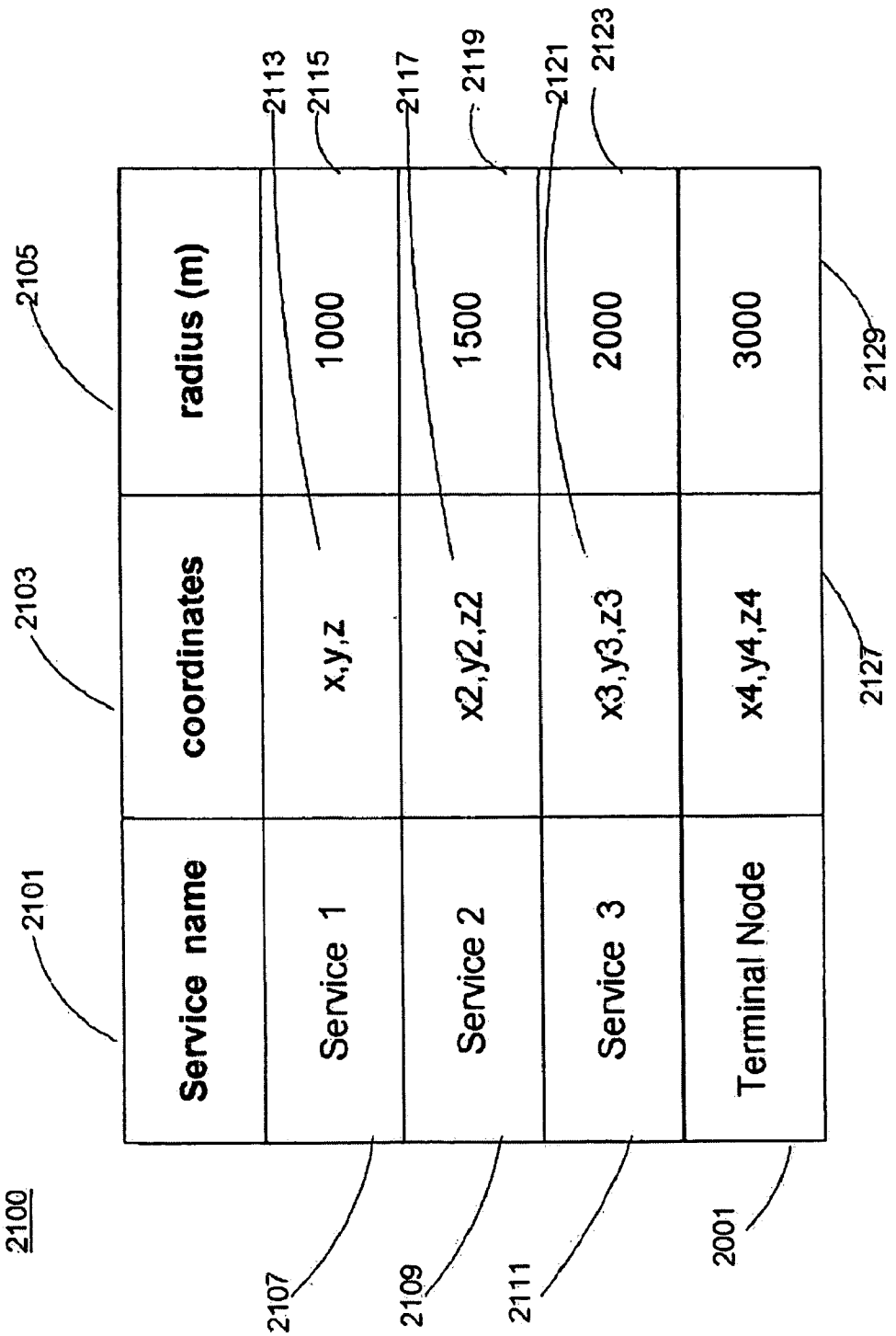

2007
2009
Service 2
Service 3
Service 1
2005
terminal node
2001
2003

FIG. 20

FIG. 21


2100
2101
2103
2105
2107
2109
2111
2113
2115
2117
2119
2121
2123
2127
2129
2001
Service name
coordinates
radius (m)
Service 1
x,y,z
1000
Service 2
x2,y2,z2
1500
Service 3
x3,y3,z3
2000
Terminal Node
x4,y4,z4
3000

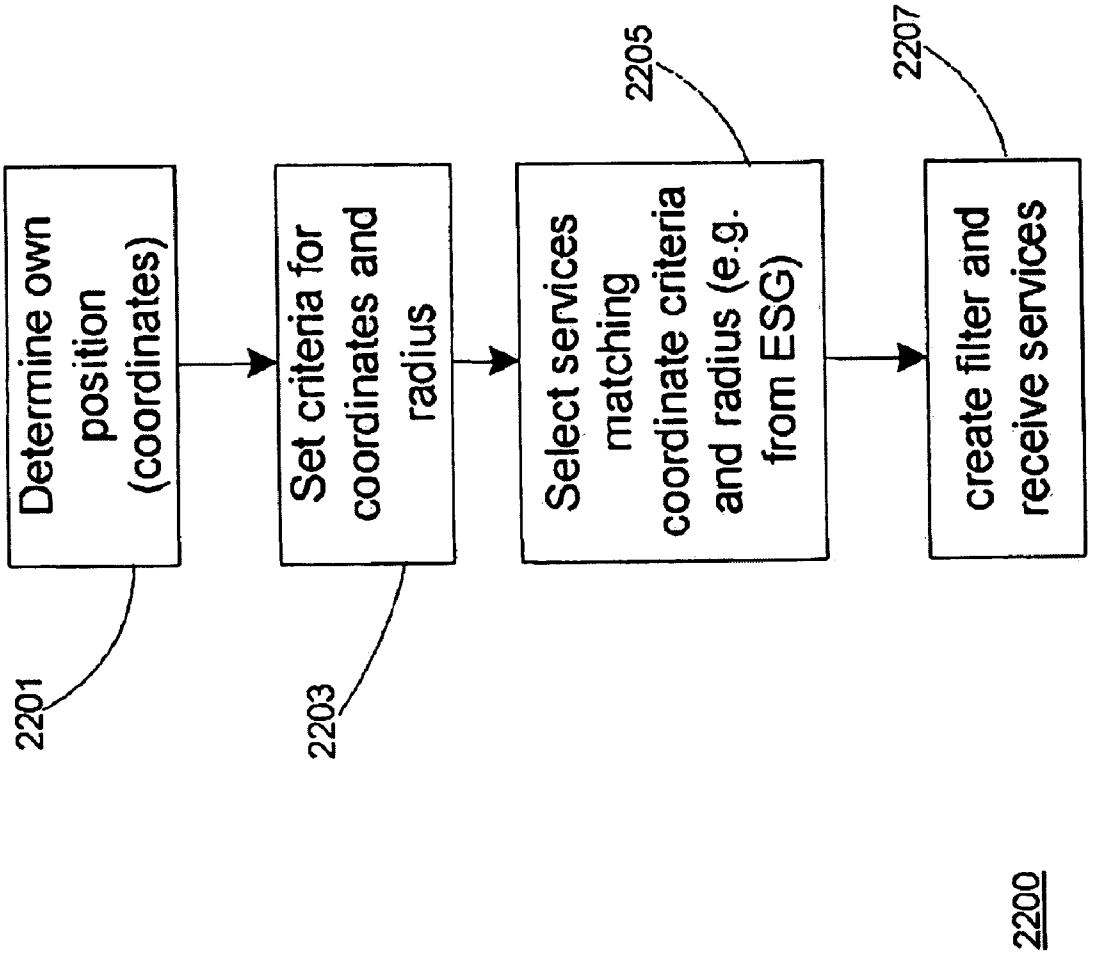

Determine own position (coordinates)
Set criteria for coordinates and radius
Select services matching coordinate criteria and radius (e.g. from ESG)
create filter and receive services
2201
2203
2205
2207
2200

FIG. 22

# DETERMINING GEOGRAPHICAL POSITION IN IPV6 NETWORKS

## CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application is a continuation of U.S. patent application Ser. No. 10/862,301 that was filed Jun. 7, 2004, the disclosure of which is incorporated by reference in its entirety.

## FIELD

**[0002]** The present invention relates to supporting geographical-based services in a communications system for a node. In particular, the invention relates to apparatus and methods in which a node provides geographical information in a reply message to a request from another node.

## BACKGROUND

**[0003]** Communication terminals are becoming increasingly portable while the supported services are becoming increasingly complex and diverse. Moreover, users require services that are based upon the location of the user. 911 emergency services is a ubiquitous example. Moreover, the number of geographical-based services is becoming more prevalent for non-emergency purposes. With mobile users carrying video-capable wireless terminals, for example, these users may wish to obtain information about restaurants in the local vicinity. By including the geographical position of the user's terminal with specific characteristics of the restaurant (e.g., type of cuisine and price range), a content server may provide a menu of a specific restaurant on the terminal's video display. The number of potential geographical-based services is staggering and is only limited by an entrepreneur's imagination.

**[0004]** With the prior art, geographical-based services are typically limited. For example, with Internet Protocol (IP) capable terminals, the location of a user is often predicated on the associated IP address. However, there may be a low correlation between the location and the value of the IP address, particularly if the IP address is static. Thus, deriving the location from the IP address may be very inaccurate. Also, with some wireless standards, such as Global System for Mobile Communications (GSM) and Universal Mobile Telecommunications System (UMTS), if a wireless terminal does have locating capabilities, position information may be included in signaling messages that are distinct from messages that contain associated data payloads.

**[0005]** Moreover, specific applications typically support associated services. With geographical-based services, solutions are typically implemented within the application layer or within the physical layer and require special software and interaction with the operator at all the associated nodes.

**[0006]** Thus, there is a real need in the industry to provide methods and apparatuses for supporting geographical-based services that integrate geographical information with existing messaging and that is flexible. For example, geographical-based services should operate transparently even though the geographical-based services may be implemented on different platforms and architectures, including hybrid systems. Moreover, it is desirable that methods and apparatuses facilitate the interfacing of geographical-based applications with the physical layer through intermediate layers such as the network layer and transport layer.

## SUMMARY

**[0007]** An aspect of the present invention provides methods and apparatus for including geographical information of a target node in a geographical response message when requested by a requesting node. Nodes may be implemented in a variety of forms including wireless terminals, laptop computers, and fixed-location telephones. The associated geographical messaging may be included in a datagram that supports both a data payload and geographical information. An embodiment of the invention supports a header extension that is compatible with IPv6 specifications, in which a geographical position, velocity information, and uncertainty information about the geographical position and the velocity information of a node are contained in a destination options header or a hop-by-hop header. The header extension is included in the datagram and may be included in a geographical message.

**[0008]** With another aspect of the invention, geographical messages are supported by a higher layer protocol. An embodiment of the invention supports messaging that is associated with the Internet Control Message Protocol (ICMP) and that is compatible with IPv6 specifications. With another variation of the embodiment, the requesting node may insert the geographical position of the requesting node when sending a request to the target node.

**[0009]** With another aspect of the invention, geographical-based systems supporting a peer-to-peer architecture are supported. A source node sends a geographical position request to a target node through the geographical-based network in order to obtain the geographical position of the target node. The target node responds to the request by returning its geographical position to the source node. The source node may send a request to a plurality of target nodes by using multicast addressing. Additionally, a target node may provide the geographical position to a source node without the source node sending a request to the target node.

**[0010]** With another aspect of the invention, geographical-based systems supporting a client-server architecture are supported. A service node functions as server that supports a geographical-based service by collecting geographical position information and/or non-geographical information from plurality of target nodes. The service node provides relevant geographical information to a source node (that functions as a client) when requested by the source node.

**[0011]** With another aspect of the invention, a node may provide geographical-based information that comprises geographical coordinates. The node may provide other variations of the geographical-based information that includes a street address in addition to or in lieu of the geographical coordinates. Moreover, a node may include non-geographical information that is associated with the node.

**[0012]** In another exemplary embodiment, a computer-readable medium is provided comprising computer-readable instructions that, upon execution by a processor, cause the processor to respond to a request for a geographically-based service. A request for a geographically-based service is received. The received request indicates that a geographical position of a target node and a radius associated with a maximum distance from the geographical position is requested. A requesting service message is formatted that is associated with a higher-layer protocol and includes an indicator indi-

cating that the geographical position of the target node and the radius is requested. The requesting service message is merged in a first header of a requesting datagram which is sent to the target node. A reply datagram is received from the target node and a reply position message component is extracted from the received reply datagram. A reply position message component is extracted from a second header of the received reply datagram. The first geographical position of the target node and the radius from the extracted reply position message component is determined. A response to the received request is provided based on the determined radius and the determined geographical position.

**[0013]** In another exemplary embodiment, a device is provided. The device includes, but is not limited to, a processor, a computer-readable medium operably coupled to the processor, and a communication interface operably coupled to the processor. The computer-readable medium comprises computer-readable instructions that, upon execution by the processor, cause the processor to respond to a request for a geographically-based service. A request for a geographically-based service is received. The received request indicates that a geographical position of a target node and a radius associated with a maximum distance from the geographical position is requested. A requesting service message is formatted that is associated with a higher-layer protocol and includes an indicator indicating that the geographical position of the target node and the radius is requested. The requesting service message is merged in a first header of a requesting datagram which is sent to the target node. A reply datagram is received from the target node and a reply position message component is extracted from the received reply datagram. A reply position message component is extracted from a second header of the received reply datagram. The first geographical position of the target node and the radius from the extracted reply position message component is determined. A response to the received request is provided based on the determined radius and the determined geographical position. The communication interface is configured to send the requesting datagram and to receive the reply datagram.

**[0014]** In another exemplary embodiment, a computer-readable medium is provided comprising computer-readable instructions that, upon execution by a processor, cause the processor to respond to a request for a geographical position. A datagram is received from a requesting node. A requesting service message that is associated with a higher-layer protocol s extracted from a first header of the received datagram. The requesting service message includes an indicator indicating that the requesting node is requesting a geographical position of the device and a radius associated with a maximum distance from the geographical position of the device for supporting a geographically-based service. The geographical position of the device is determined. A response position message component that is associated with a higher-layer protocol is formatted. The response position message component contains the determined geographical position and the radius. The response position message component is merged in a second header of a response datagram. The response datagram is sent to the requesting node.

**[0015]** In another exemplary embodiment, a device is provided. The device includes, but is not limited to, a processor, a computer-readable medium operably coupled to the processor, and a communication interface operably coupled to the processor. The computer-readable medium comprises computer-readable instructions that, upon execution by the processor, cause the processor to respond to a request for a geographical position. A datagram is received from a requesting node. A requesting service message that is associated with a higher-layer protocol s extracted from a first header of the received datagram. The requesting service message includes an indicator indicating that the requesting node is requesting a geographical position of the device and a radius associated with a maximum distance from the geographical position of the device for supporting a geographically-based service. The geographical position of the device is determined. A response position message component that is associated with a higher-layer protocol is formatted. The response position message component contains the determined geographical position and the radius. The response position message component is merged in a second header of a response datagram. The response datagram is sent to the requesting node. The communication interface is configured to receive the datagram and to send the response datagram.

**[0016]** In another exemplary embodiment, a system is provided. The system includes a first device and a second device. The first device includes, but is not limited to, a first processor, a first computer-readable medium operably coupled to the first processor, and a first communication interface operably coupled to the first processor. The first computer-readable medium comprises computer-readable instructions that, upon execution by the first processor, cause the first processor to respond to a request for a geographically-based service. The second device includes, but is not limited to, a second processor, a second computer-readable medium operably coupled to the second processor, and a second communication interface operably coupled to the second processor. The second computer-readable medium comprises computer-readable instructions that, upon execution by the second processor, cause the second processor to respond to a request for a geographical position.

**[0017]** In an exemplary embodiment, a method of responding to a request for a geographical position of a target node is provided. A reply datagram is received from a target node at an access point. If a geographical position of the target node is included in the received reply datagram is determined. If the geographical position of the target node is included in the received reply datagram, the received reply datagram is forwarded to a requesting node. If the geographical position of the target node is not included in the received reply datagram, the geographical position of the access point is determined. A response position message component that is associated with a higher-layer protocol is formatted. The response position message component contains the determined geographical position of the access point. The response position message component is merged in a header of a second reply datagram. The second reply datagram is sent to the requesting node.

**[0018]** In another exemplary embodiment, a computer-readable medium is provided comprising computer-readable instructions that, upon execution by a processor, cause the processor to perform the operations of the method of responding to a request for a geographical position of a target node.

**[0019]** In another exemplary embodiment, a device is provided. The device includes, but is not limited to, a processor, a computer-readable medium, and a communication interface. The computer-readable medium and the communication interface operably couple to the processor. The computer-readable medium comprises instructions that, upon execution by the processor, perform the operations of the method of responding to a request for a geographical position of a target

node. The communication interface is configured to receive the reply datagram and to send the second reply datagram.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0020]** A more complete understanding of the present invention and the advantages thereof may be acquired by referring to the following description in consideration of the accompanying drawings, in which like reference numbers indicate like features and wherein:

**[0021]** FIG. **1** shows an Internet reference model in accordance with prior art;

**[0022]** FIG. **2** shows an architecture of a communications system that supports a geographical-based service in accordance with an embodiment of the invention;

**[0023]** FIG. **3** shows a flow diagram for a node, as shown in FIG. **1**, in accordance with an embodiment of the invention;

**[0024]** FIG. **4** shows a flow diagram for an access point, as shown in FIG. **1**, in accordance with an embodiment of the invention;

**[0025]** FIG. **5** shows a flow diagram for a content server, as shown in FIG. **1**, in accordance with an embodiment of the invention;

**[0026]** FIG. **6** shows a first exemplary layout of a message that supports a geographical-based service in accordance with an embodiment of the invention;

**[0027]** FIG. **7** shows a second exemplary layout of a message that supports a geographical-based service in accordance with an embodiment of the invention;

**[0028]** FIG. **8** shows a system model for a Ping application with GPIPv6 support in accordance with an embodiment of the invention;

**[0029]** FIG. **9** shows a system Model for a Traceroute application with GPIPv6 support in accordance with an embodiment of the invention;

**[0030]** FIG. **10** shows a layered architecture in accordance with an embodiment of the invention;

**[0031]** FIG. **11** shows an IPv6 datagram format in accordance with an embodiment of the invention;

**[0032]** FIG. **12** shows a format for a Position Information Request message in accordance with an embodiment of the invention;

**[0033]** FIG. **13** shows a format for a Position Information Reply message in accordance with an embodiment of the invention;

**[0034]** FIG. **14** shows a flow diagram for a geographical-based application in accordance with an embodiment of the invention;

**[0035]** FIG. **15** shows a continuation of the flow diagram shown in FIG. **14**;

**[0036]** FIG. **16** shows a message scenario for supporting a geographical-based application in accordance with an embodiment of the invention;

**[0037]** FIG. **17** shows an architecture for a node that supports a geographical-based service in accordance with an embodiment of the invention;

**[0038]** FIG. **18** shows an architecture of a network that supports a geographical-based service in conjunction with a DVB-T network in accordance with an embodiment of the invention;

**[0039]** FIG. **19** shows a portion of a service area that is supported by the DVB-T network that is shown in FIG. **18**;

**[0040]** FIG. **20** shows serving regions for a node corresponding to different geographical-based services and a range set by the node within the communications system that is shown in FIG. **2**;

**[0041]** FIG. **21** represents a service configuration that is associated with an Electronic Service Guide (ESG) of a communications system that supports geographical-based services in accordance with an embodiment of the invention; and

**[0042]** FIG. **22** shows a flow diagram for the node, as shown in FIG. **20**, in accordance with an embodiment of the invention.

## DETAILED DESCRIPTION

**[0043]** In the following description of the various embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration various embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural and functional modifications may be made without departing from the scope of the present invention.

**[0044]** FIG. **1** shows an Internet reference model **100** in accordance with prior art. Internet model **100**, as embodied in the TCP/IP suite of protocols, resembles but varies slightly from the OSI model. User interfaces **101**, **103**, and **105** interface to applications **107** and **109** (corresponding to an applications layer). Applications **101**, **103**, and **105** interface to the transport layer (TCP **111** and UDP **113**) providing an IP payload that is contained in IP datagram. The IP datagram is supported by the Internet Protocol **117** (which corresponds to the network layer). Internet Protocol **117** interfaces to network **131** through the link layer (**119**, **123**, or **127**) and the physical layer (**121**, **125**, and **129**).

**[0045]** The Internet Control Message Protocol (ICMP) **115**, which is specified in RFC 792 (The Internet Engineering Task Force, "Internet Control Message Protocol"), defines a set of error and control messages that provide indications that errors have occurred in the transmission of an IP packet. Other ICMP messages provide diagnostic information to a requesting node. As shown in FIG. **1**, ICMP **115** is typically associated with IP **117** and depends on the support of IP to function. ICMP **115** is higher in the protocol hierarchy, even though ICMP **115** is associated somewhere between the network layer (third layer) and the transport layer (fourth layer). In the description herein, ICMP **115** is associated with the third plus layer. All associated protocols that are as high or higher in the protocol hierarchy are considered as being higher layer protocols.

**[0046]** The Internet Control Message Protocol as specified in RFC 792 does not support geographical-based services. For example, ICMP informational messages do not currently accommodate geographical position information.

**[0047]** FIG. **2** shows an architecture of a communications system **200** that supports a geographical-based service in accordance with an embodiment of the invention. As an example, a node **207** establishes a data connection to a wireless attachment point **213**, which provides access for node **207** to a network **209**. Network **209** supports geographical-based services for nodes **201**-**207**. (Wireless attachment point **213** provides access for nodes **205** and **207**, while a wireless attachment point **211** provides access for nodes **201** and **203**.) Wireless attachment point **213** may be implemented in a number of ways, including a wireless local area network (WLAN) access point, a router, a hub, a bridge, a BlueTooth

access point, and a base station of a wireless system. The base station may support different wireless standards, including General Packet Radio Service (GPRS) and Universal Mobile Telecommunications System (UMTS). A node (e.g., nodes **201-207**) may correspond to different terminal types, including a mobile phone or a computer, such as a laptop or personal computer (PC) that may change location or that may be stationary. Also, the node may interact with network through a communications channel, including a wireless communications channel, a dial-up telephone connection, and a cable connection.

**[0048]** In the exemplary embodiment, node **207** comprises a mobile node that communicates to network **209** over a wireless communications channel. In the embodiment, node **207** transmits and receives IPv6 datagrams that support a geographical-based service, although other embodiments of the invention may support datagrams with another format. The IPv6 datagrams are compatible with RFC 2460 (e.g., Internet Protocol, Version 6, December 1998). Moreover, the embodiment additionally utilizes an extension header to provide geographical information in the datagram. The geographical information includes a geographical position that is associated with node **207**. For example the geographical position may comprise the approximate location of node **207**. The geographical information may include other information such as a velocity of node **207**. The geographical information is explained in greater detail in the context of FIGS. **9** and **10**. In the following discussion, a geographical extension header that contains geographical position data, e.g., as latitude, longitude, and altitude, is referred as a GPIPv6 header.

**[0049]** In the embodiment, datagrams from node **207** are routed from wireless attachment point **213** through a router **219** to a content server **215**. From the geographical position of node **207**, content server **215** determines what services can be supported for node **207**. For example, communications system **200** may be configured to support different services in different serving areas. In the exemplary embodiment shown in FIG. **2**, nodes **205** and **207** are approximately located at geographical position **1** and nodes **201** and **203** are approximately located at geographical position **2**. (In the embodiment, the geographical position is provided by the node. However, in other embodiments, the geographical position may be inserted by an entity of the serving network, e.g., attachment point **213**.) Content server **215** parses the geographical position and associates a corresponding IPv6 source address with the geographical position. In addition, content server **215** associates services and/or announcements with the IPv6 address of node **207**. Table 1 illustrates an exemplary mapping of the IPv6 addresses of nodes **201-207** to the corresponding geographical positions, services and announcements.

TABLE 1

Service Configuration

| IPv6 address | Geographical position | Services | Announcements |
|---|---|---|---|
| 1 | 1 | Service set 1 | Set 1 |
| 2 | 1 | Service set 1 | Set 1 |
| 3 | 2 | Service set 2 | Set 2 |
| 4 | 2 | Service set 2 | Set 2 |

**[0050]** FIG. **3** shows a flow diagram **300** for a node (e.g., node **207**), as shown in FIG. **2**, in accordance with an embodiment of the invention. Step **301** starts process **300**. In step **303**, node **207** establishes a connection to attachment point **213**. In step **305**, a datagram that contains the geographical position of node **207** is transmitted from node **207** requesting for services and announcements from content server **215**.

**[0051]** FIG. **4** shows a flow diagram **400** for an access point (e.g., wireless attachment point **213**), as shown in FIG. **2**, in accordance with an embodiment of the invention. Step **401** starts process **400**. In step **403**, the access point waits for a datagram from node **207**. If a datagram is received from node **207**, as determined by step **405**, wireless attachment point **213** determines if a geographical position has been inserted by node **207**. If not, wireless attachment point **213** inserts a geographical position that corresponds to the location of wireless attachment point **213** in step **407**. In step **409**, the datagram is forwarded to the content server, as designated in the destination address of the datagram, through router **219**. Process **400** is repeated for the next received datagram in step **411**.

**[0052]** FIG. **5** shows a flow diagram **500** for a content server (e.g., content server **215**), as shown in FIG. **2**, in accordance with an embodiment of the invention. Step **501** starts process **500**. In step **503**, content server **215** Waits for a datagram with a GPIPv6 header. If such a datagram is received, as determined by step **505**, content server **215** parses the geographical position data and associates the determined position with the IPv6 source address (that is contained in the IP datagram), which corresponds to node **207** in step **507**. In step **509**, content server **215** associates available services and announcements that are available to node **207** for the geographical position of node **207** (as illustrated in Table 1).

**[0053]** FIG. **6** shows an exemplary layout of a message **600** that supports a geographical-based service in accordance with an embodiment of the invention. Datagram **600** comprises header information **601** (such as the source IP address and the destination address) and data payload **637**. Also, datagram **600** comprises geographical position information about a source device corresponding to a option type data field **640**, an option length data field **641**, a reserved data field **649**, a version data field **651**, a datum data field **653**, a latitude data field **603**, a longitude data field **605**, an altitude data fields **607** and **639**, velocity data fields **609**, **611**, **613**, and **615**, location uncertainty data fields **617**, **619**, **621**, **623**, and **625**, velocity uncertainty data fields **627**, **629**, **631**, and **633**, and time data field **635**. Time data field **635** is a 40-bit field that contains the current time and data in Coordinated Universal Time (UTC) and Modified Julian Date (MJD). Field **635** is coded as 16 bits providing 16 LSBs of the MJD followed by 24 bits that represent 6 digits in a 4-bit Binary-Coded Decimal (BCD). In the exemplary embodiment, the geographical information is contained in a destination options header or in a hop-by-hop header, in compliance with RFC 2460. In the embodiment, a destination options header and a hop-by-hop header may be contained in the same datagram.

**[0054]** Referring to FIG. **6**, the full width corresponds to 32 bits (4 octets). However, other embodiments of the invention may utilize different data field alignments and different data widths for any of the data fields. In the exemplary embodiment, the data fields may be contained in a header that is compatible with RFC 2460.

**[0055]** In the exemplary embodiment, version data field **651** is a 8-bit field that indicates the version of the message header. Datum data field **653** is a 8-bit field that indicates the used map datum (e.g., standard MIL-STD-2401) for deter-

mining the geographical position. Latitude data field **603** is a 32-bit field that indicates the latitude value of the source device (e.g., corresponding to an approximate location of node **207**) presented in ANSI/IEEE Std 754-1985 format. Longitude data field **605** is a 32-bit field that indicates the longitude value of the source device presented in ANSI/IEEE Std 754-1985 format. Alt indicator data field **639** is a 1-bit field indicating the use of altitude information. Altitude data field is a 16-bit field that indicates the altitude value of the source device presented in ANSI/IEEE Std 754-1985 format.

**[0056]** Velocity indicator data field **609** is a 1-bit field indicating the use of velocity information. If velocity information is included, this field is set to '1'. Otherwise this field is set to '0'. Heading data field **611** is a 16-bit field that indicates the direction where the mobile node is moving. If velocity indicator data field **609** is set to '0', this field is ignored. Otherwise, this field is included and is set to the angle of axis of horizontal velocity uncertainty, in units of 5.625 degrees, in the range from 0 to 84,375 degrees, where 0 degrees is True North and the angle increases toward the East. Vertical velocity data field **613** is an 8-bit field, which indicates the vertical velocity of the mobile node. Vertical velocity data field **613** is used if field **609** is set to '1'. Horizontal velocity data field **615** is a 16-bit field that indicates the horizontal velocity of the mobile node. If velocity indicator is set to '1', this field is in use. Once used, the horizontal speed is set in units of 0.25 m/S, in the range from 0 to 511.75 m/s. Otherwise this field is ignored.

**[0057]** Loc_Unc_H indicator data field **617** is a **1** -bit field which indicates the horizontal position uncertainty, including elliptical. If elliptical horizontal position uncertainty information is included in this response element, this field is set to '1'. Otherwise, this field is set to '0'. Loc_Unc angle data field **619** (angle of axis of the standard error ellipse for horizontal position uncertainty) is a 8-bit field indicating the angle of axis of the standard error ellipse for horizontal position uncertainty. If Loc_Unc_H indicator field **617** is set to '0', this field is ignored. Otherwise, this field is included and is set to angle of axis for horizontal position uncertainty, in units of 5.625 degrees, in the range from 0 to 84.375 degrees, where 0 degrees is True North and the angle increases toward the East. Loc_Unc A data field **621** (standard deviation of error along angle specified for horizontal position uncertainty) is a 8-bit field indicating the Standard deviation of error along angle specified for horizontal position uncertainty. If Loc_Unc A data field **621** is set to '0', this field is ignored. Otherwise, this field is included and is set to represent the standard deviation of the horizontal position error along the axis corresponding to Loc_Unc angle data field **619**. Loc_Unc P data field **623** (standard deviation of error along angle specified for horizontal position uncertainty) is a 8-bit field indicating standard deviation of error along angle specified for horizontal position uncertainty. If Loc_Unc P data field **623** is set to '0', this field is ignored. Otherwise, this field is included and is set to represent the standard deviation of the horizontal position error perpendicular to the axis corresponding to Loc_Unc angle data field **619**. Loc_Unc vertical data field **625** (standard deviation of vertical error for position uncertainty) is a 8-bit field indicating standard deviation of vertical error for position uncertainty.

**[0058]** Vel_Unc angle data field **627** (angle of axis of standard error ellipse for horizontal velocity uncertainty) is a 8-bit field indicating the angle of axis of standard error ellipse for horizontal velocity uncertainty. If Vel_Unc angle data field **627** is set to '0', this field is ignored. Otherwise, this field is set to the angle of axis for horizontal velocity uncertainty, in units of 5.625 degrees, in the range from 0 to 84,375 degrees, where 0 degrees is True North and the angle increases toward the East. Vel_Unc A data field **629** (standard deviation of error along angle specified for horizontal velocity uncertainty is a 8-bit field indicating standard deviation of error along angle specified for horizontal velocity uncertainty. If velocity indicator data field **609** is set to '1', this field is included and is set to represent the standard deviation of the horizontal velocity error along the angle corresponding to Vel_Unc angle data field **627**. Vel_Unc P data field data field **631** (standard deviation of error perpendicular to angle specified for horizontal velocity uncertainty) is a 8-bit field indicating standard deviation of error perpendicular to angle specified for horizontal velocity uncertainty. If velocity indicator data field **609** is set to '1', this field is included and is set to represent the standard deviation of the horizontal velocity error perpendicular to the angle corresponding to Vel_Unc angle data field **627**. Otherwise, this field is ignored. Vel_Unc vertical data field **633** (standard deviation of vertical velocity error) is an 8-bit field indicating the standard deviation of vertical velocity error.

**[0059]** In the embodiment, location uncertainty data fields **619-625** may be used to define a geographical area, where the data of location uncertainty data fields may not be as specified by Standards, but can be used by an application for conveying region information. In such a case, the application could recognize the use of location uncertainty data fields **619-56** and/or the variation from the specification as indicated in some other field of the header.

**[0060]** FIG. **7** shows a second exemplary layout of a message **700** that supports a geographical-based service in accordance with an embodiment of the invention. Datagram **700** comprises header information **701** (such as the source IP address and the destination address) and data payload **737**. Also, datagram **700** comprises geographical position information about a destination position corresponding to a option type data field **740**, an option length data field **741**, a reserved data field **757**, a version data field **751**, a datum data field **753**, a latitude data field **703**, a longitude data field **705**, an altitude data field **707**, and radius fields **709** and **755**. In the exemplary embodiment, the geographical information is contained in a destination options header or in a hop-by-hop header, in compliance with RFC 2460.

**[0061]** Referring to FIG. **7**, the full width corresponds to 32 bits (4 octets). However, other embodiments of the invention may utilize different data field alignments and different data widths for any of the data fields. In the exemplary embodiment, the data fields may be contained in a header that is compatible with RFC 2460.

**[0062]** In the exemplary embodiment, version data field **751** is an 8-bit field that indicates the version of the message header. Datum data field **753** is a 8-bit field that indicates the used map datum (e.g., standard MIL-STD-2401) for determining the geographical position. Latitude data field **603** is a 32-bit field that indicates the latitude value of the destination position presented in ANSI/IEEE Std 754-1985 format. Longitude data field **705** is a 32-bit field that indicates the longitude value of the destination position presented in ANSI/IEEE Std. 754-1985 format. Alt indicator data field **739** is a 1-bit field indicating the use of altitude information. Altitude data field is a 16-bit field that indicates the altitude value of the destination position presented in ANSI/IEEE Std 754-1985 format. Radius data field **709** is a 16-bit field that indicates the

horizontal radius in meters from the destination position. Radius indicator data field is a 1-bit field that indicating the use of the radius information that is contained in radius data field **709**. If set to '1', radius data field **709** is present.

**[0063]** With the embodiment, a separate message is not required to provide geographical information. An IPv6 datagram, shown in FIGS. **6** and **7**, may carry both geographical information as Well as a payload that is associated with a geographical-based feature. (Other embodiments may use other messages and other formats that may not be bound to the source or destination.) Combining these functions into the same datagram may facilitate processing the datagrams by a server that supports the geographical-based service. In a variation of the invention, header information in message **700** (corresponding to destination position) may be included in the same message as message **600** (corresponding to source position) in the same datagram. The header information may be supported in an IPv6 destination options header or in an IPv6 hop-by-hop header.

**[0064]** FIG. **8** shows a system model **800** for a Ping application with GPIPv6 (Geographical Position Internet Protocol, IP version 6) support in accordance with an embodiment of the invention. The Ping application utilizes GPIPv6 messaging that includes Internet Control Message Protocol (ICMP). In the embodiment, source (requesting) node **801** sends an echo request message in a request IP datagram (in compliance with an Internet Protocol version (IPv6) specification) to target nodes **803**, **805**, and **807** through routers **813**, **815**, **817**, and **819** in IPv4/IPv6 network **851**. The echo request message may be an ICMPv6 informational message. (Another embodiment of the invention may use another type of ICMPv6 informational message as will be discussed.) In the embodiment, target nodes **803**, **805**, and **807** are GPIPv6-capable terminals. A terminal may have a fixed position or a mobile position. When a target node **803**, **805**, or **807** receives an echo request message, the target node returns geographical information to source node **801** using a higher layer protocol, e.g., ICMP informational messages. In the embodiment, target node **803**, **805**, or **807** returns an echo reply message and GPIPv6 extension header (e.g., a destination options header or a hop-by-hop header as previously discussed) in a reply datagram to source node **801**. A datagram format is shown in FIG. **11** that will be discussed. The echo reply message may be an ICMPv6 informational message and the extension header contains the geographical position of the corresponding target node. In the embodiment shown in FIG. **8**, if target node. **803**, **805**, or **807** is not GPIP-capable, the target node returns an echo reply message without any GPIP information.

**[0065]** As shown in FIG. **8**, source node **801** and target nodes **803**, **805**, and **807** have a peer-to-peer relationship. For example, source node **801** can send a request directly to target node **803** and vice versa. However, the embodiment of the invention can also support a client-server architecture. In a client-server architecture, a server node may manage a geographical-based service on behalf of a client (e.g., source node **801**). As an example, a server node may maintain geographical information for a plurality of nodes and report pertinent information to a requesting node that may be predicated on the geographical position of the requesting node.

**[0066]** FIG. **9** shows a system model **900** for a Traceroute application with GPIPv6 support in accordance with an embodiment of the invention. The Traceroute application utilizes GPIPv6 messaging that includes Internet Control Message Protocol (ICMP). In the embodiment, source (requesting) node **901** sends an echo request message in a request IP datagram (in compliance with an Internet Protocol version (IPv6) specification) to target node **903** through routers **909**, **911**, **913**, **915**, **917**, and **919** in a IPv4/IPv6 network **951**. The echo request message may be an ICMPv6 informational message. In the embodiment, target node **903** and routers **909**, **911**, **913**, **915**, **917**, and **919** are GPIPv6-capable. Each router **909**, **911**, **913**, **915**, **917**, and **919** return an echo reply message to source node **901** as the request IP datagram is routed to target node **903**. Each router includes its geographical position in an extension header with an echo reply message in concert with the datagram format as shown in FIG. **11**. When target node **903** receives an echo request message, target node **903** returns geographical information to source node **901**.

**[0067]** FIG. **10** shows a layered architecture **1000** in accordance with an embodiment of the invention. Access layer **1001** corresponds to a physical layer and a link layer (layers **1** and **2**). Networks **851** and **951** support IPv4 with connectivity layer **1005** and IPv6 with connectivity layer **1003**. Networks **851** and **951** may be compatible with both IPv4 and IPv6 protocol specifications. Connectivity layer **1003** supports GPIPv6 protocol **1007** on top of IPv6 protocol. The IPv6 protocol corresponds to the network layer (layer **3**). In the disclosure; a protocol at a hierarchical level of GPIPv6 protocol **1007** or higher is considered to be a higher layer protocol. GPIPv6 protocol **1007** includes the specification of ICMPv6 informational messages that support GPIPv6.

**[0068]** FIG. **11** shows an IPv6 datagram format **1100** in accordance with an embodiment of the invention. With the embodiment, a GPIPv6 datagram comprises header **1101**, extension header **1103**, an ICMPv6 informational message, TCP header **1113**, and payload. **1115**. In the embodiment, the ICMPv6 informational message comprises message type field **1105** (corresponding to a value of 128 for an echo request message and **129** for an echo reply message), a code field **1107** (which will be discussed later), checksum field **1109**, and message field **1111**. Extension header **1103** corresponds to a destination options header (as previously discussed). Extension header **1103** includes the geographical position of the corresponding target node. (The embodiment also supports other extension header such as a hop-by-hop header as previously discussed.) Also, the embodiments, as shown in FIGS. **8** and **9**, enable the source node to include its geographical position by including an extension header with the requesting datagram.

**[0069]** FIG. **12** shows a format for Position Information Request message **1200** in accordance with an embodiment of the invention. In the embodiment, the Position Information Request message **1200** functions as the ICMPv6 informational message. Message **1200** includes a message type **1201** (corresponding to Position Information Request), a code field **1203**, a checksum field **1205**, and GPIPv6 header **1207** that is optionally included in the Position Information Request message **1200**. While format **1100** includes geographical position information in extension header **1103** that is separate from the ICMPv6 informational message, message **1200** includes the geographical position of the requesting (source) node.

**[0070]** In the embodiment, Position Information Request message **1200** optionally includes the geographical position of the requesting node by setting the value of code field **1203** to '1' and inserting extension header **1103**. If Position Information Request message **1200** does not contain the geographical position of the requesting node, the value of code field **1203** to '0'.

**[0071]** Although message **1200** optionally includes geographical coordinates of the requesting node, other geographical information, e.g., the street address of the requesting node, may be included in the message body of the Position Information Request message.

**[0072]** FIG. **13** shows a format for Position Information message **1300** in accordance with an embodiment of the invention. Message **1300** includes message type **1301**, code field **1303**, checksum field **1305**, and GPIPv6 header **1307**. GPIPv6 header includes geographical coordinates of the responding (target) node. As with Position Information Request message **1300**, the street address of the responding node may be included. Moreover, associated non-geographical information may be included in the Position Information message **1200**. Examples of non-geographical information will be discussed with FIG. **16**. If the target node is not GPIPv6 capable and does not consequently support Position Information Request and Position Information messages **1200** and **1300**, the target node may return an error message (e.g., parameter problem) in accordance with RFC 792. In the embodiment, code field **1303** equals '0' corresponds to a reply to a Position Information Request message. If code field **1303** equals '1', then the Position Information message contains the geographical position of the source node and is not a reply to a Position Information Request message.

**[0073]** In another embodiment of the invention, three ICMPv6 informational messages are supported. As with the previous embodiment, the embodiment supports the Position Information Request message. Moreover, the embodiment supports the Position Information Reply message, which provides the reply to the Position Information Request message, and the Position Information Indication message, which provides the geographical position of the source node to a target node.

**[0074]** GPIPv6 data may be protected, if needed, by using IPv6 security features such as defined in RFC 2406 (The Internet Engineering Task Force, "IP Encapsulating Security Payload (ESP)"). The security of IPv6 is described in RFC 2401 (The Internet Engineering Task Force, "Security Architecture for the Internet Protocol"). Alternatively, GPIPv4 data can be used without protection if the network provides adequate protection. Moreover, authentication can be provided by using a separate Authentication header as defined in RFC 2460. For encrypted GPIPv6 data, authentication can be similarly provided as unencrypted GPIPv6 data or by using the authentication mechanism available within the IP Encapsulating Security Payload (ESP) header.

**[0075]** FIG. **14** shows a flow diagram **1400** for a geographical-based application in accordance with an embodiment of the invention. The process shown in FIGS. **14** and **15** uses the ICMPv6 informational messages as previously discussed. However, other embodiments of the invention may use other ICMPv6 informational message or may use messaging supported by another higher layer protocol. In step **1401**, a user of a requesting node (e.g., source node **801** as shown in FIG. **8**) initiates a request for a geographical-based service. In step **1403**, the associated geographical-based application processes the request. If the user request entails determining the position of a target node, as determined in step **1405**, a Position Information Request message with the address of the associated target node is formatted in step **1407**. The address may identify a single target node or may identify a plurality of target nodes using a multicast address. Step **1409** determines if the geographical position of the requesting node should be included in the Position Information Request message. If so, in step **1411** a geographical position header is included in the Position Information Request message. In the embodiment, the format of the geographical position header has a format as shown in FIG. **6** or FIG. **7**. An IPv6 datagram is sent to the target node in step **1413**.

**[0076]** In process **1400**, if step **1417** determines that the source node is reporting its geographical position to a target node but is not requesting a reply from the target node, then the geographical position is included in a Position Information message in step **1419**. An IPv6 datagram is sent to the target node in step **1413**.

**[0077]** FIG. **15** shows a continuation of flow diagram **1400** shown in FIG. **14**. (Step **1415** corresponds to step **1415** in FIG. **14**.) If the source node is expecting a reply from the target node in response to sending a Position Information Request message to the target node, step **1501** determines if a Position Information message is received. If so, the geographical position of the target node is extracted from the received message in step **1503**. If not, the source node waits for the expected reply. The received geographical position of the target node is provided to the geographical-based application in step **1505**. In step **1507**, the user is provided an output that conveys the geographical position.

**[0078]** In an embodiment, before a target node returns its geographical position in response to a Position Information Request message, the target node accesses a GPIPv6 policy database (GPD) to determine if the requesting node has sufficient rights to obtain the location parameters and if the latest location information delivered to the requesting node has expired. If so, the target node inserts a GPIPv6 header within the reply message (e.g., Position-information message **1300** with code field **1303** equal to '0'). If the target node accepts the request from the requesting node, code field **1303** is set to an appropriate value.

**[0079]** FIG. **16** shows a message scenario **1600** for supporting a geographical-based application in accordance with an embodiment of the invention. Message scenario **1600** can be associated with different applications, in which requesting node **1651** and service node **1653** have a client-server relationship. Service node **1653** obtains geographical-based information from monitoring nodes **1655** and **1657**. For example, service node **1653** can provide an automotive traffic advisory service by collecting traffic congestion information from monitoring nodes **1655** and **1657**. In message scenario **1600**, service node **1653** queries nodes **1655** and node **1657** by sending Position Information Request messages **1601** and **1605**, respectively. Nodes **1655** and **1657** report traffic locations that are experiencing traffic congestion by returning Position Information messages **1603** and **1607**, respectively. Each monitoring includes the geographical position where traffic congestion is occurring.

**[0080]** Requesting node **1651** requests for a traffic report by sending Position Information Request message **1609**, which includes the geographical position of requesting node **1651** to service node **1653**. Service node **1653** obtains the geographical position of requesting node **1651** and matches the position with geographical information that is received from monitoring nodes **1655** and **1657**. Serving node **1653** returns the relevant geographical information to requesting node **1651** by returning Position Information message **1611**.

**[0081]** While scenario **1600** shows a reply message (e.g., message **1601**) being sent in response to a request message (e.g., message **1603**), with another embodiment of the inven-

tion, a node can send geographical information without receiving a request. For example, node **1655** may periodically send geographical information or and automatically send geographical information if a certain event (e.g., a traffic jam at an associated street intersection) occurs.

**[0082]** A node may return geographical information that comprises geographical coordinates or that is represented by some other format such as a street address. Also, non-geographical information, in addition or in lieu of geographical information, can be returned by a node. As an example, scenario **1600** may represent a gasoline-pricing service, in which the price of gasoline and the location of the associated gasoline station are returned.

**[0083]** Embodiments of the invention support numerous geographical-based services with either peer-to-peer or with client-server architectures. For example, a user associated with a source node can locate another user associated with a target node (e.g., a wife looking for her husband in a busy shopping mall), in which the associated nodes have a peer-to-peer relationship. Moreover, the target node need not be associated with another user (e.g., a user looking for a key chain) if the target node (e.g., a key chain) has integrated circuitry to support the geographical-based service. With a client-server architecture, embodiments support numerous applications including automotive traffic reports, vehicle fleet tracking, and emergency services.

**[0084]** FIG. **17** shows an architecture for a node **1700** (e.g., a source node or a target node) that supports a geographical-based service in accordance with an embodiment of the invention. Node **1700** comprises a processor **1701**, a communications module **1703**, a memory **1705**, a user interface **1707**, and a location determination module **1709**. Processor **1701** executes computer instructions that are retrieved from memory **1705**. Also, processor **1701** retrieves and saves data from/to memory **1705**.

**[0085]** Node **1700** (that may correspond to node **207** as shown in FIG. **2**) communicates with access point **213** (as shown in FIG. **2**) through communications module **1703**. In the exemplary embodiment, communications module supports a wireless communications channel and transmits through an antenna **1711**. However, other embodiments of the invention may support other communications channels such as a dial-up telephone connection that do not necessitate antenna **1711**.

**[0086]** In the embodiment, node **1700** obtains geographical position information through location determination module **1709**. Location determination module comprises a Global Position Satellite (GPS) receiver in order to derive position information. Location determination module **1709** receives radio signals through antenna **1713** from a plurality of GPS satellites. From the gathered information, location determination module **1709** derives an approximate position of node **700**.

**[0087]** Other embodiments of the invention may utilize other methods for determining a geographical position of node **1700**, including, assisted GPS, cell identification (corresponding to the location of the cell that node is located), and time difference of arrival (TDOA). In some embodiments, antenna **1713** may not be implemented because antenna may not be required to determine the geographical position of node **1700**.

**[0088]** A user may provide commands and data to node **1700** through user interface **1707**. For example, the user may input an approximate set of position coordinates (e.g., latitude and longitude) rather than having location determination module **1709** deriving the geographical position of node **1700**. Also, if node **1700** receives a datagram from another node, in which the datagram contains another geographical position of the other node, the other geographical position may be displayed on user interface **1707**.

**[0089]** FIG. **18** shows a network architecture **1800** that supports a geographical-based service in conjunction with a Digital Video Broadcasting-Terrestrial (DVB-T) network **1805** in accordance with an embodiment of the invention. (With other embodiments of the invention, network **1805** may support other digital video broadcasting standards, e.g., ATSC, ISDB, and DVB-H.) A node **1801** is connected to an interaction network **1803** (which may be supported by network **209** as shown in FIG. **2**) through a wireless communications channel. To illustrate services that can be supported by network **1800**, a user (e.g., a restaurant) of node **1801** wishes to send: a video message to other nodes in the vicinity the restaurant in order to broadcast a special meal of the day. The broadcasting of the advertisement is supported by DVB-T network **1805**. DVB-T network **1805** typically has unidirectional transmission capabilities to nodes and typically is capable of supporting multicast services with massive data bandwidth for the downlink communications channel. DVB-T network **1805** may not have an appreciable capacity of directly receiving messages from nodes (corresponding to the uplink communications channel).

**[0090]** In the architecture shown in FIG. **18**, node **1801** requests for the advertisement to be broadcast by DVB-T network **1805** through interaction network **1803**. Node **1801** initiates the request by sending datagram **1851**, which includes a GPIPv6 header and other data, to interaction network **1803**. In the embodiment, interaction network **1803** supports an interaction network protocol in order to interact with DVB-T network **1805**. Node **1801** specifies a region **1807** over which the advertisement is to be broadcast. In the example shown in FIG. **18**, nodes **1809-1813** are within region **1807** and thus nodes **1809-1813** receive the advertisement when the advertisement is broadcast. Region **1807**, which is an approximate circle, is determined by a specified radius and a destination position that correspond to the approximate radius and center, respectively. (The destination position may correspond to the geographical position of node **1801** or may be a set of coordinates that is different from the geographical position of node **1801**.) In order to specify the destination coordinates and the radius, node **1801** may send an IPv6 datagram that includes header information and a data payload (corresponding to the advertisement) as shown in FIG. **7**.

**[0091]** FIG. **19** shows a portion of a service area **1900** that is supported by the DVB-T network **1805** that is shown in FIG. **18**. Service area **1900** is supported by cells **1901-1907**. Region **1807**, as specified by node **1801**, is contained entirely with cell **1903**. Thus, DVB-T network **1805** broadcasts an advertisement from node **1801** over cell **1903**. Also, the embodiment supports a scenario in which a requested region spans a plurality of cells. For example a requested region **1951** spans cells **1901-1905**. If node **1801** were to specify region **1951** rather than region **1807**, the advertisement would be broadcast over cells **1901-1905**.

**[0092]** FIG. **20** shows serving regions for different geographical-based services that communications system **200** (as shown in FIG. **2**) can support a node **2001** for the range set by node **2001**. In the example shown in FIG. **20**, system **200** is

configured to support different services in different regions. A service **1** is supported in region **2005**; a service **2** is supported in region **2007**; and a service **3** is supported in region **2009**. System **200** may notify node **2001** about the service configuration by sending an announcement that provides a service guide, e.g., an Electronic Service Guide (ESG). (The ESG is discussed in more detail with FIG. **21**.) Node **2001** is configured to receive broadcasts over an approximate circular region **2003**, in which the center corresponds to the position of node **2001** and the radius is specified by the user of node **2001** through a user interface (e.g., user interface **1707** as shown in FIG. **17**). In the exemplary embodiment, as shown in FIG. **20**, node **2001** is able to receiver services **1** and **3**.

**[0093]** FIG. **21** represents a service configuration **2100** that is associated with a service guide (e.g., Electronic Service Guide (ESG)) of communications system **200** for supporting geographical-based services in accordance with an embodiment of the invention. Service configuration **2100** corresponds to the service configuration that is shown in FIG. **20**. Each geographical-based service is supported over an approximate circular region that is specified by center coordinates **2103** and radius **2105**. Service **2107** (service **1**) has center coordinates **2113** and radius **2115**. Service **2109** (service **2**) has center coordinates **2117** and radius **2119**. Service **2111** (service **3**) has center coordinates **2121** and radius **2123**. Node **2001** is located at center coordinates **2127** and specifies radius **2129** for services. With the corresponding geometry, node **2001** determines what services are available at its current location. Of course, if node **2001** changes locations, a different set of services may be available and thus are recalculated.

**[0094]** FIG. **22** shows a flow diagram **2200** for the node **2001** for determining available services in accordance with an embodiment of the invention. If a service is available and if the user wishes to utilize the service, the service is configured in a filter. The filter processes datagrams that are associated with the selected services. In step **2201**, node **2001** determines its position coordinates, e.g. utilizing location determination module **1709** (as shown in FIG. **17**). In step **2203**, node **2001** sets criteria for determining available services by utilizing center coordinates **2127** and radius **2129**. In step **2205**, using the service configuration broadcast by system **2000** in an announcement, node **2101** selects services that match coordinate and radius criteria. In the example shown in FIG. **20**, node **2001** correspondingly selects service **2107** (service **1**) and service **2111** (service **3**). In step **2207**, node **2001** configures a message filter, in which datagrams corresponding to service **2107** and service **2111** are processed.

**[0095]** As can be appreciated by one skilled in the art, a computer system with an associated computer-readable medium containing instructions for controlling the computer system can be utilized to implement the exemplary embodiments that are disclosed herein. The computer system may include at least one computer such as a microprocessor, digital signal processor, and associated peripheral electronic circuitry.

**[0096]** While the invention has been described with respect to specific examples including presently preferred modes of carrying out the invention, those skilled in the art will appreciate that there are numerous variations and permutations of the above described systems and techniques that fall within the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

**1**. A computer-readable medium comprising computer-readable instructions therein that, upon execution by a processor, cause the processor to provide a response to a request for a geographically-based service, the instructions configured to cause a computing device to:

receive a request for a geographically-based service, the received request indicating that a geographical position of a target node and a radius associated with a maximum distance from the geographical position is requested;

format a requesting service message that is associated with a higher-layer protocol, the requesting service message including an indicator indicating that the geographical position of the target node and the radius is requested;

merge the requesting service message in a first header of a requesting datagram;

send the requesting datagram to the target node;

receive a reply datagram from the target node;

extract a reply position message component from a second header of the received reply datagram;

determine the geographical position of the target node and the radius from the extracted reply position message component; and

provide a response to the received request based on the determined radius and the determined geographical position.

**2**. The computer-readable medium of claim **1**, further comprising determining whether the computing device is within the service area of the geographically-based service based on the determined radius and the determined geographical position and a second geographical position of the computing device.

**3**. The computer-readable medium of claim **1**, wherein the requesting service message is selected from the group consisting of an echo request message and a position information request message.

**4**. The computer-readable medium of claim **1**, wherein the requesting service message comprises an extension header and an echo reply message.

**5**. The computer-readable medium of claim **4**, wherein the extension header is selected from the group consisting of a destination option header and a hop-by-hop header.

**6**. The computer-readable medium of claim **1**, wherein the determined geographical position is selected from the group consisting of geographical coordinates and a physical location address.

**7**. The computer-readable medium of claim **1**, further comprising decrypting the reply position message component.

**8**. The computer-readable medium of claim **1**, wherein the requesting datagram further includes an authentication header.

**9**. The computer-readable medium of claim **1**, wherein the requesting datagram complies with an Internet Protocol version 6 specification, and wherein the requesting service message comprises an Internet control message protocol version 6 informational message.

**10**. The computer-readable medium of claim **1**, wherein the reply datagram complies with an Internet Protocol version **6** specification.

**11**. The computer-readable medium of claim **1**, wherein the requesting datagram further includes a geographical position of the computing device.

12. The computer-readable medium of claim 11, wherein the geographical position of the computing device is inserted in an extension header of the requesting datagram.

13. The computer-readable medium of claim 11, wherein the geographical position of the computing device is inserted in a message body of the requesting service message.

14. A device comprising:

a processor;

a computer-readable medium operably coupled to the processor, the computer-readable medium comprising instructions that, upon execution by the processor, perform operations comprising

receiving a request for a geographically-based service, the received request indicating that a geographical position of a target node and a radius associated with a maximum distance from the geographical position is requested;

formatting a requesting service message that is associated with a higher-layer protocol, the requesting service message including an indicator indicating that the geographical position of the target node and the radius is requested;

merging the requesting service message in a first header of a requesting datagram;

sending the requesting datagram to the target node;

receiving a reply datagram from the target node;

extracting a reply position message component from a second header of the received reply datagram;

determining the geographical position of the target node and the radius from the extracted reply position message component; and

providing a response to the received request based on the determined radius and the determined geographical position; and

a communication interface operably coupled to the processor, the communication interface configured to send the requesting datagram and to receive the reply datagram.

15. The device of claim 14, wherein the operations further comprise determining whether the device is within the service area of the geographically-based service based on the determined radius and the determined geographical position and a second geographical position of the device.

16. The device of claim 14, wherein the requesting service message is selected from the group consisting of an echo request message and a position information request message.

17. The device of claim 14, wherein the requesting service message comprises an extension header and an echo reply message.

18. The device of claim 17, wherein the extension header is selected from the group consisting of a destination option header and a hop-by-hop header.

19. The device of claim 14, wherein the determined geographical position is selected from the group consisting of geographical coordinates and a physical location address.

20. The device of claim 14, wherein the operations further comprise decrypting the reply position message component.

21. The device of claim 14, wherein the requesting datagram further includes an authentication header.

22. The device of claim 14, wherein the requesting datagram complies with an Internet Protocol version 6 specification, and wherein the requesting service message comprises an Internet control message protocol version 6 informational message.

23. The device of claim 14, wherein the reply datagram complies with an Internet Protocol version 6 specification.

24. The device of claim 14, wherein the requesting datagram further includes a geographical position of the device.

25. The device of claim 24, wherein the geographical position of the device is inserted in an extension header of the requesting datagram.

26. The device of claim 24, wherein the geographical position of the device is inserted in a message body of the requesting service message.

27. A computer-readable medium comprising computer-readable instructions therein that, upon execution by a processor, cause the processor to respond to a request for a geographical position, the instructions configured to cause a computing device to:

receive a datagram from a requesting node;

extract a requesting service message that is associated with a higher-layer protocol from a first header of the received datagram, the requesting service message including an indicator indicating that the requesting node is requesting a geographical position of the computing device and a radius associated with a maximum distance from the geographical position of the computing device for supporting a geographically-based service;

determine the geographical position of the computing device;

format a response position message component that is associated with a higher-layer protocol, the response position message component containing the determined geographical position and the radius;

merge the response position message component in a second header of a response datagram; and

send the response datagram to the requesting node.

28. The computer-readable medium of claim 27, further comprising determining if the requesting node has permission to obtain the geographical position and the radius.

29. The computer-readable medium of claim 27, wherein determining the geographical position comprises obtaining the geographical position from a serving network.

30. The computer-readable medium of claim 27, wherein determining the geographical position comprises obtaining the geographical position from a user interface.

31. The computer-readable medium of claim 27, wherein determining the geographical position utilizes a time difference of arrival technique.

32. The computer-readable medium of claim 27, wherein the received datagram complies with an Internet Protocol version 6 specification, and wherein the response position message component comprises an Internet control message protocol version 6 (ICMPv6) informational message.

33. The computer-readable medium of claim 32, wherein the determined geographical position is contained in the ICMPv6 informational message.

34. The computer-readable medium of claim 27, wherein the operations further comprise encrypting the response position message component.

35. A device comprising:

a processor;

a computer-readable medium operably coupled to the processor, the computer-readable medium comprising instructions that, upon execution by the processor, perform operations comprising

receive a datagram from a requesting node;
extract a requesting service message that is associated with a higher-layer protocol from a first header of the received datagram, the requesting service message including an indicator indicating that the requesting node is requesting a geographical position of the device and a radius associated with a maximum distance from the geographical position of the device for supporting a geographically-based service;
determine the geographical position of the device;
format a response position message component that is associated with a higher-layer protocol, the response position message component containing the determined geographical position and the radius;
merge the response position message component in a second header of a response datagram; and
send the response datagram to the requesting node; and
a communication interface operably coupled to the processor, the communication interface configured to receive the datagram and to send the response datagram.

**36**. The device of claim **35**, further comprising determining if the requesting node has permission to obtain the geographical position and the radius.

**37**. The device of claim **35**, wherein determining the geographical position comprises receiving the geographical position from a serving network.

**38**. The device of claim **35**, wherein determining the geographical position comprises obtaining the geographical position from a user interface.

**39**. The device of claim **35**, wherein determining the geographical position utilizes a time difference of arrival technique.

**40**. The device of claim **35**, wherein the received datagram complies with an Internet Protocol version 6 specification, and wherein the response position message component comprises an Internet control message protocol_version 6 (ICMPv6) informational message.

**41**. The device of claim **40**, wherein the determined geographical position is contained in the ICMPv6 informational message.

**42**. The device of claim **35**, wherein the operations further comprise encrypting the response position message component.

**43**. A system comprising:
a requesting device, the requesting device comprising
a first processor;
a first computer-readable medium operably coupled to the first processor, the first computer-readable medium comprising first instructions that, upon execution by the first processor, perform first operations comprising
receiving a request for a geographically-based service, the received request indicating that a geographical position of a target device and a radius associated with a maximum distance from the geographical position is requested;
formatting a requesting service message that is associated with a higher-layer protocol, the requesting service message including an indicator indicating that the geographical position of the target device and the radius is requested;
merging the requesting service message in a first header of a requesting datagram;
sending the requesting datagram to the target device;
receiving a reply datagram from the target device;
extracting a reply position message component from a second header of the received reply datagram;
determining the geographical position of the target device and the radius from the extracted reply position message component; and
providing a response to the received request based on the determined radius and the determined geographical position; and
a first communication interface operably coupled to the first processor, the first communication interface configured to send the requesting datagram and to receive the reply datagram; and
the target device comprising
a second processor;
a second computer-readable medium operably coupled to the second processor, the second computer-readable medium comprising second instructions that, upon execution by the second processor, perform second operations comprising
receiving the requesting datagram from the requesting device;
extracting the requesting service message from the first header of the received requesting datagram;
if the extracted requesting service message includes the indicator, determining the geographical position of the target device;
formatting the reply position message component, the reply position message component containing the determined geographical position and the radius;
merging the reply position message component in the second header of the reply datagram; and
sending the reply datagram to the requesting device; and
a second communication interface operably coupled to the second processor,
the second communication interface configured to receive the requesting datagram and to send the reply datagram.

**44**. The system of claim **43**, wherein the requesting datagram complies with an Internet Protocol version 6 specification, and wherein the response position message component comprises an Internet control message protocol version 6 (ICMPv6) informational message.

**45**. The system of claim **44**, wherein the determined geographical position is contained in the ICMPv6 informational message.

**46**. A device comprising:
a processor;
a computer-readable medium operably coupled to the processor, the computer-readable medium comprising instructions that, upon execution by the processor, perform operations comprising
receive a reply datagram from a target node;
determine if a geographical position of the target node is included in the received reply datagram;
if the geographical position of the target node is included in the received reply datagram, forward the received reply datagram to a requesting node;
if the geographical position of the target node is not included in the received reply datagram, determine the geographical position of the device;
format a response position message component that is associated with a higher-layer protocol, the response

position message component containing the determined geographical position of the device;

merge the response position message component in a header of a second reply datagram; and

send the second reply datagram to the requesting node; and

a communication interface operably coupled to the processor, the communication interface configured to receive the reply datagram and to send the second reply datagram.

**47**. The device of claim **46**, wherein the reply datagram complies with an. Internet Protocol version 6 specification, and wherein the response position message component comprises an Internet control message protocol version 6 (ICMPv6) informational message.

**48**. The device of claim **47**, wherein the determined geographical position is contained in the ICMPv6 informational message.

**49**. A method for responding to a request for a geographical position of a target node, the method comprising:

receiving a reply datagram from a target node at an access point;

determining if a geographical position of the target node is included in the received reply datagram;

if the geographical position of the target node is included in the received reply datagram, forwarding the received reply datagram to a requesting node;

if the geographical position of the target node is not included in the received reply datagram, determining the geographical position of the access point;

formatting a response position message component that is associated with a higher-layer protocol, the response position message component containing the determined geographical position of the access point;

merging the response position message component in a header of a second reply datagram; and

sending the second reply datagram to the requesting node.

**50**. The method of claim **49**, wherein the reply datagram complies with an Internet Protocol version 6 specification, and wherein the response position message component comprises an Internet control message protocol_version 6 (ICMPv6) informational message.

**51**. The method of claim **50**, wherein the determined geographical position is contained in the ICMPv6 informational message.

**52**. A computer-readable medium comprising computer-readable instructions therein that, upon execution by a processor, cause the processor to respond to a request for a geographical position of-a target node, the instructions configured to cause a computing device to:

receive a reply datagram from a target node;

determine if a geographical position of the target node is included in the received reply datagram;

if the geographical position of the target node is included in the received reply datagram, forward the received reply datagram to a requesting node;

if the geographical position of the target node is not included in the received reply datagram, determine the geographical position of the computing device;

format a response position message component that is associated with a higher-layer protocol, the response position message component containing the determined geographical position of the computing device;

merge the response position message component in a header of a second reply datagram; and

send the second reply datagram to the requesting node.

**53**. The computer-readable medium of claim **52**, wherein the reply datagram complies with an Internet Protocol version 6 specification, and wherein the response position message component comprises an Internet control message protocol_version 6 (ICMPv6) informational message.

**54**. The computer-readable medium of claim **53**, wherein the determined geographical position is contained in the ICMPv6 informational message.

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